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BELL TELEPHONE STATISTICS.

We publish elsewhere in this issue a copious abstract of the annual Bell telephone report for 1902. It is an impressive exhibition of growth and strength, and might, indeed, be cited in all fairness as a remarkable evidence of the stimulating effect of competition on an industry which had become so "monopolized" it had ceased to keep pace with its legitimate opportunities of expansion. There can be no question in the mind of any one who watches the situation as to the vigor and ability that characterizes the management; nor can the fact be lost sight of that somewhat in proportion as the cry of "monopoly" is ceasing to have any significance or effect, the efficiency of the Bell system and its general cheapness to the public user grow. It is to be noticed, for example, that the number of daily connections is returned at 9,322,951, an increase daily of more than a million and a half over 1901.

President Fish remarks very truly that even now there is hardly a section of the country where the supply of telephone facilities equals the demand. In view of the extraordinary efforts put forth by the independents during the past five or six years, it might seem that the demand had overtaken the supply. But Mr. Fish's statement will stand any test applied to it; and there is no reason to imagine that the introduction of the telephone can catch up with the need for it for many years to come. The percentages of telephones to given population are not particularly illuminative, for while the best show how many telephones there may happen to be in any community, they do not indicate any point of "saturation" or "refusal." In fact, the ease with which electrical output steadily doubles on itself was one of the remarkable exhibits of the late census inquiry; and it is not less true of telephony than of other branches of electrical application that the market does seem to be practically illimitable. Incidentally it may be noted that in copper circles the allegation has been made lately that telephony is calling for copper in greater quantity than either electric lighting or street railway work. We have no means of confirming this interesting assertion, but it is undeniable that the bulk of copper required by telephony at the present rate of introduction is tremendous.

Under these conditions, the increase in Bell capitalization, which will give the parent company at no distant date a total of $250,000,000, should not be surprising. No one can say just how soon that figure will be reached, but the company must meet its proportion of the requirements of the sub-organizations all over the country, and that meant last year nearly forty millions, it appears. If the parent company puts up half that amount annually it will not be long in meeting the upper limit of its new capitalization; while, if present indications mean anything, it should be just as able then as now to maintain its present rate of dividend over the larger amount. It is merely a question of adequate facilities, good service and moderate rates.

THE FOUNDER OF THE SMITHSONIAN.

One of the earliest museums and educational establishments for the people in this country is the Smithsonian Institution in Washington, founded by the liberality of an Englishman named Smithson. It appears that this founder was buried in Genoa and that the cemetery is being removed, so that his remains lack a final resting place. It would have seemed that at this juncture all that was needed was for the authorities of the Smithsonian to know the facts and hasten

with pious alacrity to bring the body of Mr. Smithson here for interment in the grounds at Washington. Apparently they did not take such action, but fortunately at this juncture Prof. A. G. Bell, who is on the board, has offered himself to sustain such expense as the Institution cannot meet. It seems to us that if there was one duty devolving on the Institution, it was to preserve the remains of its generous founder, thus exposed to ignominy and desecration, and we can hardly conceive of any circumstances that would stand in the way of such laudable action. We are very glad to see that Prof. Bell has stepped into the gap; but we hasten to say that if further financial difficulty is expected, this journal will esteem it an honor to raise the necessary funds, or to guarantee the sum required to treat with honor and decency the memory and ashes of one who did so much for science in America through the admirable Institution that was created by his gift to our country.

THE RELATIVE DISPOSITION OF POWER WIRES AND TELEPHONE WIRES.

A paper on this subject, read by Mr. P. M. Lincoln, at the last meeting of the A. I. E. E., deals with the conditions which occur when a telephone circuit comprising a pair of conductors is carried on the same poles as high-pressure alternating-current transmission lines, say of three wires. As is well known, if the telephone wires are transposed relatively to each other, at regular intervals, the disturbing effect of the powerful currents in the power-wires will be neutralized, and destroyed in the telephone circuit. But in addition to transposition of the wires, there must be a symmetry between the two sides of the telephone circuit. If one side is grounded, or has greater leakage than the other, or, if a telephone receiver is inserted in one side, and not in the other, a dissymmetry will be produced, which may render the telephone circuit absolutely useless for conversational purposes. Moreover, the potentials in space in the neighborhood of a high-tension transmission line may be considerable. If a pair of telephone conductors occupies this region, the potential of the circuit may become very considerable, and unless the telephone lines are elaborately insulated, the electrostatic stress may cause a break-down in the insulation of the telephone line, with dissymmetry and consequent powerful inductive disturbance. This effect is enhanced when the power system becomes accidentally grounded on one side.

WATER-COOLED RHEOSTATS.

Elsewhere we print an article describing the interesting electrochemical laboratory which Prof. R. S. Hutton has built up in connection with his course in electrochemistry at Owens College, Manchester, England. One of the prominent features of the laboratory that will be noted is the practical character of the equipment, which, moreover, is suitable both for purposes of illustrating theory and for prosecuting original research. One detail to which we desire particularly to refer is the use made of the water-cooled rheostat. A 40-kw furnace employs a rheostat for regulating current up to a maximum strength of 1,000 amperes. The first steps of the rheostat are of manganin wire to carry currents up to 300 amperes. The last steps are of water-conveying german-silver tube, not more than half an inch in diameter, to carry current up to 1,000 amperes.

The range of pressures and currents employed in electrochemistry is considerable. Starting with 2 volts in some electroplating work, there are numerous plants generating dekavolts, and many generating hektovolts. The nitric acid process is said to take 10 kilovolts. Under such variable conditions, an experimental electrochemical plant must possess a considerable degree of elasticity in regard to volts and amperes. In the nitric acid process described as at Niagara, there are about 7,000 arcs formed and extinguished per second, employed in setting fire to some of the nitrogen in the circumambient air. This current is, therefore, a periodically fluctuating one. In calcium-carbide production—a purely electro-thermal process—the current is usually alternating. In nearly all other electrochemical applications a direct current is employed.

The current strength employed in electrochemical operations runs up to thousands of amperes, and involves varied problems for adequate and cool conduction, of which the water-pipe rheostat is a particular case. When it is desired to dissipate much thermal energy locally, there is nothing like water. There is scarcely any cure for obstreperous thermal activity so effective as a little cold water. A gramme of water per minute will readily wash away a watt. The energy storage capacity of ordinary water is something marvelous. The principle has been made use of in a great variety of electrical applications aside from electrochemical processes. Not only is it used in the cooling of the oil in which transformers are submerged, but it is also used to cool pipes themselves employed as conductors. A large dynamo may be short-circuited on a rheostat made of iron pipe enclosing flowing water, without any danger of destroying the apparatus by excessive heat. Indeed, where the quantity of electrically-generated heat to be dissipated is at all considerable, to use at this day an ordinary wire rheostat instead of the water-pipe resistance would be an anachronism.

ELECTRIC WAVE MODELS.

An interesting model of the wave motion along a single-phase alternating-current line was exhibited by Prof. Franklin at the last meeting of the A. I. E. E. It is well known that a helical line drawn upon the surface of a transparent cylinder gives rise to a peculiar optical effect when the cylinder is uniformly rotated, and regarded from one side. The rotating screw-line looks like a series of advancing waves, if the direction of rotation is in one sense, or like a series of retreating waves if the rotation is in the opposite sense. By making the pitch of the screw equal to the wave-length on the model, and by giving the cylinder as many twists or revolutions per second as the periods or frequency of the single-phase current, the waves move along the model with the proper speed corresponding to the actual transmission of waves along the actual line imitated in miniature. By placing two screw-lines of the same pitch, on the rotating shaft, but one right-handed and the other left-handed, the optical effect is to show the waves advancing from the sending end to the receiving end, and then, after reflection, retreating towards the sending end.

Such undiminished waves would correspond to the transmission of waves along a circuit of perfect conductance and perfect insulation. Owing, however, to the effects of resistance and leakage, the waves steadily attenuate as they run, and, on the model, this is imitated by giving to the screw-lines a correspondingly diminishing radius along the revolving shaft. By placing on the shaft a right-handed dwindling screw for the advancing waves, and a left-handed screw dwindling backwards for the reflected waves, as well as a compound screw to represent the sum of these two components, the model is made to show to the eye the two component sets of waves and also the resultant set. Either component set alone would show a series of waves dwindling logarithmically, but their joint effect is a series of waves that mutually superpose and oppose at successive distances of a quarter wave length. The resultant waves may thus indicate marked humps and hollows with an amplitude exceeding that at the origin, or the condition commonly called line resonance.

Of course, the model described can only illustrate the waves corresponding to one set of terminal conditions. It might be possible to

carry the plan a step further, and employ a model in which the screw lines could be adjusted and clamped in phase and magnitude to correspond to different terminal conditions, so as to represent to the eye the effects of a very wide range of terminal conditions such as the change from no load to full load. Any such mechanical illustration possesses great power to aid the mind in grasping the phenomena of alternating-current transmission, which, being invisible in nature, require full elucidation to apprehend.

Three-Phase Measurements.

In our correspondence columns this week we print a letter from Mr. Faccioli on a subject which has recently drawn the attention of some of our readers. The power-factor of a single-phase alternating-current circuit is the ratio of the real to the apparent power, or of the watts to the volt-amperes. Corresponding to this power-factor is a virtual angle of lag or lead in the current, whereby a sinusoidal e.m.f. would produce at the stated lag or lead a sinusoidal current of strength equal to that observed in the real circuit. The cosine of this phase angle is then the power-factor. But whereas the power-factor always has a real existence if the volt-amperes be measured, the angle of lag corresponding thereto may be entirely fictitious, a mere figment of the imagination, when the voltage and current are not sinusoidal.

In the case of a three-phase system, if the volt-amperes are measured in the same definite manner, that is, delta-fashion, then the ratio of the real power in watts to the sum of these volt-amperes, is the power-factor of the circuit; but if the volt-amperes are measured in any other way, the apparent power of the circuit may be different, and, therefore, the power-factor different. The relations of the power-factor to the various lag angles will be simple when the system is balanced, and the periodic quantities are all sinusoidal. It will be complex when the system is out of balance, and when the periodic quantities are complex. In general, the lag angles have but little importance, while the power-factor of the system is a definitely measurable quantity. The power-factor of the system differs, however, from the power-factor of the three sides of the system, when the system is not in balance, and will generally be different from the arithmetical mean of the power-factors on the three sides of the system, considered separately.

Power-factor indicators are sometimes found on central-station switchboards, in triplets, one for each side of the system. It is, however, possible to arrange the apparatus in such a manner that a pointer will indicate on a dial the power-factor of the three-phase system considered singly, or as a whole. Mr. Faccioli gives another demonstration of the proposition that two wattmeters connected on a delta, three-phase system will jointly indicate the total power delivered over three wires. This demonstration is, perhaps, the simplest yet offered. It involves considering the vector sum of two electromotive forces as equal to the third side of their triangle. This demonstration would have been most acceptable in the past when the two-wattmeter method was first discovered, and when the demonstration of the method was harrassing in its complexity.

The Electrified Farmer.

It is seldom that this journal can claim place as the mouthpiece of the horny-fisted agriculturalist. But this week we get close down to the sod and begin our bucolic log-rolling in earnest. If at some later date we seek rural support as the organ of the farmer's candidate for President, we feel that we have made a good beginning. In brief, it gives us joy this week to present to our agricultural readers an account of experiments on the relation of kilovolt-amperes and such like things to the growth of beans and tobacco. A distinguished Norwegian professor has spent many years in the study of this world-astonishing theme and has derived, albeit by somewhat empirical methods, certain conclusions that will shake the Produce Exchange with inextinguishable merriment. We were not aware that they raised much in Norway save timber and men, both of admirable quality, but if Prof. Lemstrom's results are to be trusted it needs only the application of electricity—negative if you do not wish to break the spell—to bring the Norwegian carrot crop where it could supply food for all the rabbits between the North Cape and Van Diemen's Land. We say carrots, because Prof. Lemstrom has shown for that succulent root an increased crop to the extent of 182.7 per cent. (do not forget the decimal) under the benign influence of the negative charge. We cannot learn whether the carrots were or were not ionized, and would suggest that samples be sent to Prof. J. J. Thomson in order that so important a point be not neglected.

Lemstrom has devised several ingenious plans for applying the electrical stimulus. In one instance he covers his experimental carrot or cabbage patch with a network of wires much like that constructed of string by those bent upon scaring away crows, and thus forms his electrode. A static machine furnishes the power, and if the stimulation is carried on in the dark of the moon and the experimenter carries the left hind foot of a graveyard rabbit in his hip pocket, the crops will be greatly increased—except cabbage, which is a hoodoo plant, and seems to break the spell. Incidentally, the crop in cereals seems to be improved in quality as well, but we greatly regret to say that details are lacking on the quality of the tobacco. If Prof. Lemstrom's ingenious process can be depended upon to transform the Connecticut leaf into genuine Vuelta Obaja wrappers we will start a movement for making its use compulsory in all the territory of the United States. Another very interesting conclusion is that certain plants only bear the electrical treatment when they are well watered. We believe that this coincides with many results recently obtained at the Wall Street experiment station.

But these and all similar experiments seem to us to belong to a class which cannot be reckoned as of the first order of precision. It reminds us of some psychological experiments in which the law of averages is worked overtime. There are many factors in the growth of plants besides electrification, and experiments on such subjects are notoriously subject to great uncertainties. The conditions are exceedingly difficult to control and the results can often be made to fit almost any preconceived theory that happens to be handy. Some thirty years ago the blue glass cure was rampant, for everything from measles to old age, and in the discussion of its virtues the stimulating effect of the blue rays on vegetation was the subject of many experiments, and if we recollect aright, a mass of evidence was collected vastly more imposing than anything which electroculture can show. Some of it may be found in the *Comptes Rendus* and other scientific journals. It was even found that light filtered through blue gauze would quicken the germination of seeds and keep away insects. The explanation vouchsafed for this remarkable fact has so familiar a sound that we venture to quote it: "The sunlight negatively electrified in passing through the meshes of the blue gauze of the frame, which is positively electrified, excites an electromagnetic current, etc., etc." It only needs a few words about ionization and electrons to pass for the vernacular of 1903. We cannot quite take electroculture seriously on the present evidence. It may or may not be true that electricity can be used practically to stimulate plant growth, but even if it can we shall only be the wiser by the electrical equivalent of barn-yard manure. The bearing of electric stimulus on plant physiology may lead to results of theoretical interest, but we do not think the farmer will lay down the fork for the influence-machine just yet.

Mayor Low on New York Subway Roads.

A letter was sent recently by Mayor Low to President Orr, of the Rapid Transit Commission, advocating the extension of the system of subways along the lines formulated by Chief Engineer Parsons and the placing of such extensions in one system. He said that the city could not advocate the plan for the purchase of the rights of the Interborough Rapid Transit Company, and he declared against the plan of Comptroller Grout for an independent tunnel to compete with the Interborough Company's system.

Mayor Low outlined the difficulties that the city experienced in getting capitalists to undertake the construction of the rapid transit tunnel, and said that the supposed $6,000,000 of profit which the Belmont syndicate may make on the construction of the subway for $35,000,000 will be offset by the loss of $6,000,000 that the company is sure to suffer on account of the low bid on the extension of the system under the East River to Brooklyn. The estimates for the work were $9,000,000, but the Belmont syndicate, in order to defeat its only competitor, the Brooklyn Rapid Transit Company, bid $3,000,000.

After declaring for a unified system of rapid transit throughout the city the Mayor said: "Four things seem to me to be absolutely essential: (1) A uniform rate of fare over every mile of road built by the use of the city's credit, from one end of the city to the other; (2) that this uniform rate of fare, at first to be 5 cents, shall be reduced as rapidly as circumstances will permit; (3) that year by year while the control of the city's system is in private hands, the city shall receive as large a percentage as possible of the earnings of the road; (4) that the city, and not the railroad, shall dictate the character of the service to be given.

Student Members of the A. I. E. E.

The board of directors of the American Institute of Electrical Engineers voted on March 27 in favor of extending certain privileges to students of electrical engineering. The official announcement is as follows:

The American Institute of Electrical Engineers has arranged to extend certain privileges to those who are regularly pursuing studies in electrical engineering. Such individuals will be designated as students of the American Institute of Electrical Engineers. A large number of students in electrical engineering in the universities and technical schools of the country can be greatly benefited by an association with the Institute. At the commencement of the present year an important step was taken for the establishment of local or branch meetings of the Institute in connection with universities and technical schools. These meetings are held, in some cases, under the direction of a professor of electrical engineering, and in other cases in connection with an electrical society or other organization conducted by the students themselves. The local meetings are held in connection with the following institutions: Massachusetts Institute of Technology, Union University, Lehigh University, Cornell University, Columbian University, Pennsylvania State College, Western University of Pennsylvania, Ohio State University, University of Cincinnati, Purdue University, University of Illinois, University of Wisconsin, University of Missouri, University of Minnesota. Meetings of these branches as well as other branches which have been formed by members of the Institute in different cities without any connection with educational institutions are usually held ten days or two weeks after the monthly meetings at New York. The papers presented at the New York meetings, together with the discussions, are furnished to the branch meetings. After these papers are presented in full or in abstract, the session is open for the presentation of additional papers by local members and for general discussion.

Experience shows that although students in these schools have become interested in the Institute, yet in many instances they are not prepared to join the Institute. For the purpose of extending valuable privileges of the Institute to these young men, and also to others who are looking forward to electrical engineering as a profession, it has been arranged that upon the payment of a very small fee, eligible students may attend the meetings of the Institute and receive copies of the meeting announcements and monthly transactions, and also purchase the semi-annual bound volumes of the transactions. To cover these privileges the following regulations have been adopted:

Students regularly pursuing electrical studies may have the following privileges, viz.: 1. The privilege of being present at all meetings of the Institute, except such business meetings as relate to the management of the Institute. 2. The privilege of receiving the regular announcements and printed copies of monthly transactions. 3. The privilege of purchasing the semi-annual bound volumes of the Transactions of the Institute at the price of $3.50 per copy, or such other price as may be hereafter fixed by the board of directors. Upon the following conditions: 1. Endorsed by one member or associate of the Institute. 2. Recommended by the board of examiners and approved by the board of directors. 3. Payment in advance of the annual sum of $3 for such privileges. 4. Be enrolled by the secretary as a student of the American Institute of Electrical Engineers. No student, however, shall have these privileges for more than three years, and these privileges may be withdrawn from any student, at any time, by a majority vote of the board of directors.

It will be noted that these privileges render eligible not only those students who are pursuing studies in higher technical institutions, but also young men who are pursuing electrical studies either through the help of correspondence schools or privately. The purpose of the Institute is to assist these young men by bringing them into closer contact with the electrical engineering profession, and furnishing them with the monthly Transactions containing valuable papers and discussions, which will be of great assistance to them in their work.

Underground Telegraph Cables in England.

Extensions have recently been planned or made for the underground telegraph service from London northward, the first section of the system, to Birmingham, having proved very useful in the last two years. The extraordinary manner in which the British aerial circuits get out of order or become useless can only be realized by those who have to study the subject, and the underground wires have become absolutely necessary. The next stage to be completed is to Warrington, the ultimate idea being to extend the cable as far as Glasgow. The line of route to be taken from Birmingham is through Walsall, Bloxwich, Bridgetown, Cannock, Stafford, Eccleshall, Woore, and Nantwich to Warrington. Roughly speaking, this is about 80 miles, and when this section is completed the total length of cable will then be 200 miles or so. The London and Birmingham cable carries 76 wires, but the Warrington extension will comprise 60 wires only.

The preliminary work of constructing the line of pipes between Birmingham and Warrington for the reception of the cable itself has already been completed, and as a temporary safeguard against the disintegrating effects of the winter storms a temporary cable of seven wires has been drawn in. The wisdom of this precautionary measure was amply demonstrated recently, for had not these wires been available on the day immediately following the gale which swept across the country with such destructive force, the telegraphic interruptions with Northern towns would have been much more serious than they were. The permanent cable of sixty wires is now in course of preparation, and early this month a start will be made to place it in position inside the three-inch iron pipes. Great care has to be exercised in the making and completing of the cable. Like the one in use between Birmingham and London, it is a paper cable. Only the most skilful and trustworthy workmen are employed and some idea of the magnitude of the job may be gathered from the fact that in connection with the Birmingham and London cable there are no fewer than 2,000 "wiped joints." Though sixty is mentioned as the probable number of wires which the cable will comprise, the number has not yet been definitely decided upon. Testing stations will be provided at Walsall, Stafford, Woore and Nantwich. The laying of the cable will, it is expected, take close upon twelve months; and by this time next year it is anticipated that the whole affair will be in working order. This British example might well be imitated by the American telegraph companies, which are also serious sufferers from the interruption of traffic by wintry storms. The telephone lines in the United States have also proved great sufferers from storms; and it will be recalled that the report of the New York & New Jersey Telephone Company printed recently in these pages, showed a most severe loss of income from damage done to aerial circuits.

Laboratory Electric Furnace Equipment, Owens College, Manchester, England.

THE publication of a recent British Institution of Electrical Engineers' paper [1] gives us an opportunity of publishing an account of the experimental equipment for electric furnace work at Owens College, Manchester. The accompanying description and illustrations are taken from the first part of this paper, but are supplemented by further details which it was thought would be of more particular interest to our readers.

This laboratory is closely in connection with the electrical engineering department of the Physical Institute from which it derives its power. Unfortunately, the university is not equipped with a central power plant as is so usual in this country, so that the available power is limited to about 50 hp, being taken from a gas engine and an electric motor, which can be used either separately or in parallel. On the other hand, the dynamo house having been fitted up to meet the requirements of experimental work, the machines are of a very varied type, and are moreover at all times available.

Any of the following units can be directly switched on to the cables leading from the dynamo house to the electro-chemical laboratory. The first unit of 40 kw direct current is capable of being connected so as to give any e.m.f. between 10 and 200 volts, the maximum current being 600 amp. This dynamo is most frequently used for arc furnace work at 50-100 volts, and there is a dynamo specially intended for electrolysis capable of giving 1,000 amp at 15 volts. With

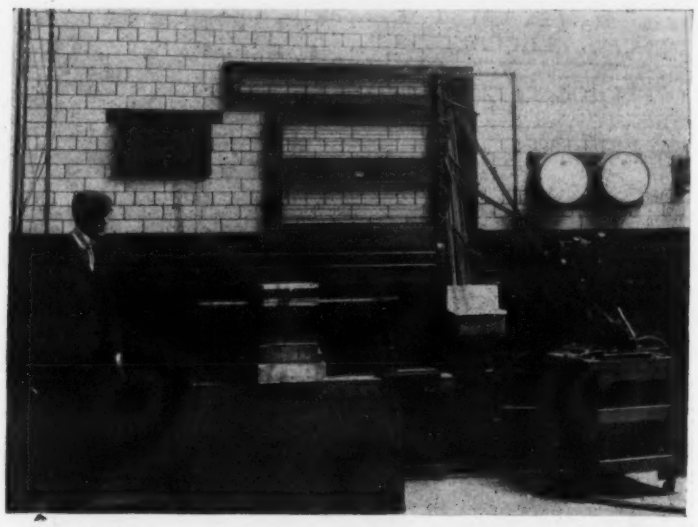


FIG. I.—REGULATING RESISTANCE, 40-KW MOISSAN FURNACE.

regard to alternating currents a 40-kw, three-phase and a 20-kw, single-phase machine are provided. The latter can be connected so as to give anything between 30 amp. at 600 volts and 250 amp. at 75 volts. A plant used some time ago by Mr. McDougall for the manufacture of nitric acid was presented by him to the laboratory, which will give alternating current up to 16,000 volts.

In the electrochemical laboratory itself, the first problem is the exact regulation of these comparatively large currents, since for satisfactorily studying some of the electrolytic processes it is absolutely essential to have the current entirely under control. A series resistance is used for this purpose, which is divided into two parts, the first of manganin wire designed particularly for starting an arc furnace, and capable of being used for currents up to 300 amp.; the second consisting of German silver tubes, water-cooled, and with maximum carrying capacity of 1,000 amp. After some consideration the water-tube resistance was chosen as being the most suitable for regulating large currents. To the right is the portable resistance, and above are the 500, 600 and 1,000-amp. short-circulating switches. Bare copper strip 1¼ x ¼ and 2 x ¼ in. connect these switches with the different frames seen in the center. The two carbons are carried in massive copper holders which can be adjusted to any given height, the leads being bolted to the vertical standard of the holder of 2¼ sq. in. cross-section. The design of the water tube frames is shown in Fig. 1, which gives a general view of the frames.

The frames are of two types, the first being made of parallel ¼-in. tubes for currents of 600 amp. and below. These tubes are let into ½-in. by 1-in. gun metal strips, which are fixed to wooden frames; each strip carries two ⅜-in. set screws serving as terminals. One of these is used for the permanent leads, the other is useful to fix any temporary connection. The second type of frame for 1,000 amp. consists of two ½-in. German silver tubes, 6½ ft. long, connected in series, and has a resistance of 0.024 ohm. Two sliders are provided, by which the actual resistance in circuit can be varied, and the current adjusted with accuracy to the value desired. There is a stiff central spring, by means of which the sliders are kept in contact with the tubes during adjustment. They can be clamped in any given position by two thumb screws.

In considering the maximum power which may be dissipated in a water tube resistance there are two principal factors. Firstly, the maximum rate at which water can be passed through the tubes; secondly, the maximum rate at which heat can be transmitted from the metal to the water. In all practical cases the first limiting factor will intervene long before the second would show its influence. The design of the water tube frame will, therefore, depend on the dimensions of the tube and the available head of water. A general guiding factor is that a flow of one litre per minute will dissipate up to 2½ kw. The larger tubes are distinctly the more satisfactory, since in this case there is no difficulty in obtaining an efficient flow of water from the ordinary supply. With the smaller tubes it is necessary to have numerous inlets and outlets, as their resistance to the flow of water is considerable.

Close to the water tubes a resistance is provided by which the exciting current of any of the dynamos can be most effectively regulated; it is in constant use for the considerable variations of voltage necessary during the progress of some of the furnace operations.

Two sets of leads are run from the dynamo house to the laboratory. The first for currents up to 1,000 amp. is there directly connected to bare copper bars running round the room. The copper bars are drilled at frequent intervals with ½-in. holes, and thus a number of different furnaces placed in any required position can easily be connected by flexible leads. The second cable from the dynamo house is for currents up to 400 amp, and is brought up to terminals in three different positions. Thus it is possible to run continuous and alternating-current furnaces at the same time. To connect the furnaces with the bus-bars a number of flexible leads of standard length are provided, in this case of 3 yards length, and each of 300 amp. carrying power.

The furnace terminals are so arranged that 2, 3 or 4 of these flexibles can be bolted on according to the current required. This system has been infinitely more convenient than a single heavy lead.

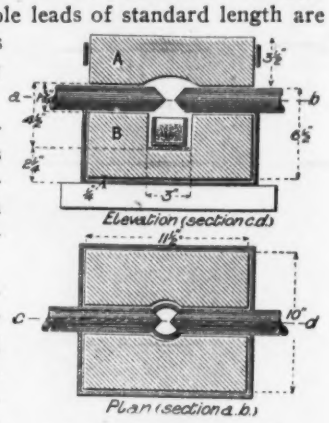


FIG. 2.—40-KW MOISSAN FURNACE.

The diverse apparatus described below has been designed expressly for experimental work of this nature and is the result of a good deal of consideration and practical trial of various forms of apparatus. The main object in view has in each case been to obtain a furnace which could easily be adapted to a number of varied requirements, and which should possess in the highest degree the advantages of strength, rigidity and simplicity of design, the question of producing the apparatus at the minimum of cost being also kept in mind. The result has been more practical than original, and whilst no claim is made to the production of any new form of furnace, the apparatus illustrated has proved itself capable of being fitted up for representing most of the more successful forms of technical furnaces in use.

Of experimental furnaces, that of Moissan takes of course a foremost place. A dimensioned drawing of this type for a power of about 40 kw is given in Fig. 2, whilst a view of the complete furnace is shown in Fig. 1. It is constructed of blocks of Monk's Park bath stone, which after trials with various limestones has proved to be the most suitable. The furnace is composed of two blocks, the first, *A*, forming the cover, the second, *B*, the furnace proper. This latter has two grooves of slightly greater diameter than the carbons to be used. As the blocks are apt to split under the influence of the heat, they are held together by iron bands; these

[1] Journ. Instit. Electr. Engineers, Vol. 32, Part 1, pp. 222-247, 1903. "High Temperature Electro-Chemistry: Notes on Experimental and Technical Electric Furnaces," by R. S. Hutton and J. E. Petavel.

are provided with sockets (not shown in figure) which enable the furnace or cover to be lifted by long iron bars. The central hole, which may be of diameter 2½-4 in., according to size of crucible in use, is lined at the bottom by a layer of powdered magnesia, which prevents the carbon crucible coming in direct contact with the lime. An annular space should be left around the crucible, which not only facilitates the heating, but also prevents the lime and carbon from entering into combination.

Provided that care is taken in the selection of the limestone used for the blocks, and that pure carbon crucibles and electrodes are employed, many most valuable preparations can be effected, as is sufficiently evidenced by the now classical work of the French savant.

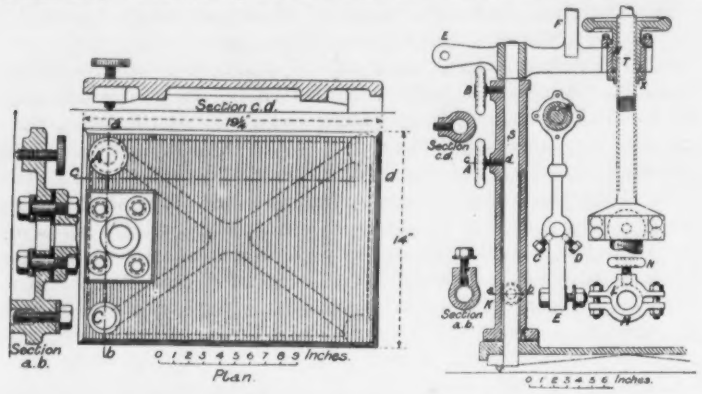


FIG. 3.—PLAN AND ELEVATION VERTICAL ELECTRIC FURNACE.

Much use can also be made of such a furnace for preliminary trials before fitting up an experiment on a larger scale, for instance the nature of a fusion product can be examined, the necessary amount of flux for the satisfactory reduction of an ore of one of the rarer metals can be approximately determined, and in many ways a good deal of time and valuable material can be saved by such small scale experiments. Largely owing to the difficulties of running such a furnace for more than a very short time and of making a process

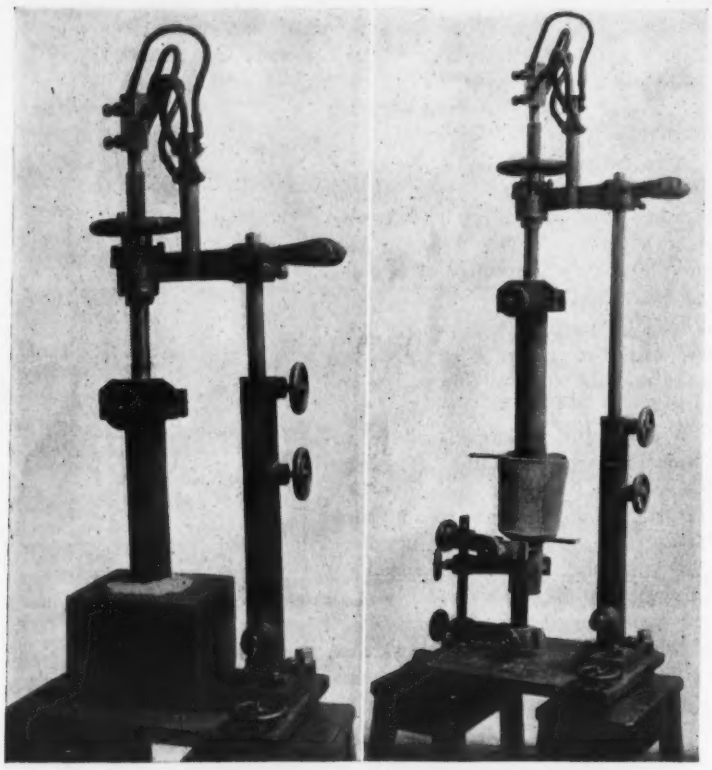


FIG. 4.—VERTICAL ELECTRIC FURNACE.

carried out by its aid continuous, the Moissan furnace gives very little assistance in indicating methods of preparation capable of being employed afterwards on a large commercial scale.

With a view to bridging over this gap between laboratory experiment and technical process several other forms of furnace have been adopted, which to a certain extent well fulfill this object. Fig. 3 shows the construction of a vertical furnace built very strongly and capable of the most varied uses.

The apparatus consists of a cast-iron base, an adjustable standard and a feeding gear. The base is ½ in. ruling thickness, strengthened with rims and cross ribs 1 in. thick. At one corner a ¾-in. bolt, *C*, serves as a terminal. *A* is a levelling screw. The square base of the standard is insulated by a slab of vulcanized fibre, and held down by four ¾-in. bolts. See section *A B*. A hollow cast-iron column, *R*, 2½ in. diameter, is fixed on to the base shown in the previous figure, but insulated from it, the height of the gun metal cross-bar carrying the screw-feeding gear can be adjusted within wide limits by means of the 1¼-in. steel rod, *S*, which is clamped in position by the hand wheels, *A* and *B*. Connection can be made at either of the terminals, *K* or *E* (the latter for currents above 600 amp), the opposite pole being connected to the base. To avoid sliding contacts, which would be objectionable for such large currents, connection from the cross-bar to the screw carrying the carbon rod is made by means of four ½-in. flexibles not shown in this figure, but which can be clearly seen in Fig. 4. The gun metal rod, *T*, which carries the carbon, is 1½ in. diameter with a square screw thread (4 threads to the inch), giving a feed of about 1 foot; it is raised or lowered by means of a 7-in. cast-iron hand wheel. The design of the carbon holder is clearly shown; it is provided with rings of various diameter, so that carbons of very different sizes up to 3 inches can be held.

Employed on a small scale as shown in Fig. 4 it can be applied to the study of the electrolysis of fused salts and in this case the exact adjustment of which the vertical carbon is capable is particularly valuable. Upon the cast-iron base which forms the negative pole

FIG. 5.—EXPERIMENTAL CARBORUNDUM FURNACE.

is placed a large block of carbon, having a cavity which serves as a crucible. The positive electrode is formed by a carbon 3 in. in diameter, which is fed by the screw-gear described above. In the second illustration the apparatus is fitted to be used for the electrolysis of fused salts; the water jacket, by causing a layer of the fused mass to solidify, enables the electrolyte itself to form the crucible lining. This is frequently necessary, since with many substances it is impossible to find a furnace material capable of withstanding their corrosive action at the high temperatures which prevail. The negative pole is in this case formed by a vertical carbon, which is held in a clamp sliding on a gun metal vertical rod fixed to the base.

On the other hand the common equipment of the laboratory of fire bricks, cast-iron pots with carbon lining, etc., enable tests of such processes as the manufacture of calcium carbide, ferro-chromium and fused alumina to be carried out on quite a satisfactory scale. The furnaces of the Acheson resistance type can also be inexpensively fitted up from the stock of fire bricks, a few pieces of flat thick boiler plate and graphite rors and blocks of varying sizes; and if constructed with due regard of the relative proportions of the materials to the power employed, exceptionally fine products of carborundum, etc., can be obtained. Such a furnace in operation is shown in Fig. 5. As clearly indicated in Fig. 6, which represents a form of carbide furnace used with much success in the laboratory, by carefully adapting materials which are usually available in a laboratory it is possible to cheaply fit up any modified plant which is required. The two carbons, which are clamped side by side in a single holder, but insulated one from another, are raised and lowered by means of a

crane fitted to the wall. The current is led in by flat copper bars, which by sliding in grooves prevent any oscillation or side motion of the apparatus. The body of the furnace consists either as shown in figure, of fire bricks, or of a large cast-iron pot; in both cases the material itself forms the actual lining.

In conclusion it may not be out of place to mention that besides being equipped with the object of intelligently following the valuable achievements of the technical processes and if possible elucidating some of the problems of a like nature which urgently require study, experimental work of a purely scientific character is being carried out. The object of the work in progress consists in the study of the effect of high gaseous pressures on the course of some of the high-pressure reactions.

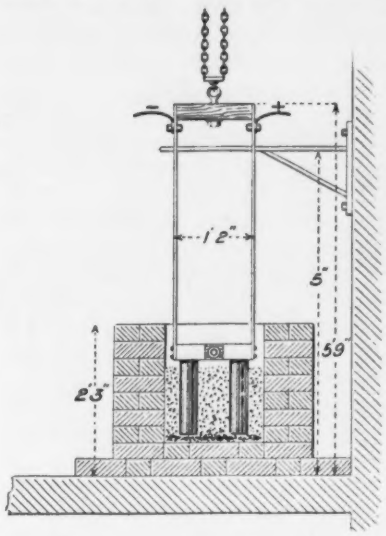


FIG. 6.—40-KW EXPERIMENTAL CARBIDE FURNACE.

The apparatus employed is shown in Fig. 7. It is intended for currents up to 1,000 volts and is capable of being permanently worked at 200 atmospheres pressure.

The apparatus is practically a steel enclosure, placed horizontally or vertically, which can be used for any of the different types of furnace. It is air-tight, and designed for a working pressure of 200 atmospheres, being tested at 500 atmospheres. On the right and left will be seen the screw-gear by which the carbons are fed, whilst in front and behind are windows which will stand the full pressure, but which can be replaced by additional connections when a circulation of gas through the apparatus is desired. The main valve, which serves also to connect the pressure gauges, will be seen on the top. The apparatus is water-jacketed throughout, the refractory material of which the furnace proper is made being contained in a cast-iron lining, thus insuring the protection of the main forging. The construction of this apparatus has been carried out by Messrs. Lennox, Reynolds and Fyfe to the designs made at the college.

The construction of this furnace has been provided out of funds received from the government grant committee of the Royal Society, London. Although it is too early to deal with any of the results of such work, it is evident that much interest attaches to the investigation of the additional influence of pressure on the reactions brought about at high temperatures attainable in the electric furnace. It is interesting and encouraging to find this appreciation in educational circles of the importance of the new domain of electrochemical work, as a branch of engineering; while the facilities afforded may well result in some original research of value.

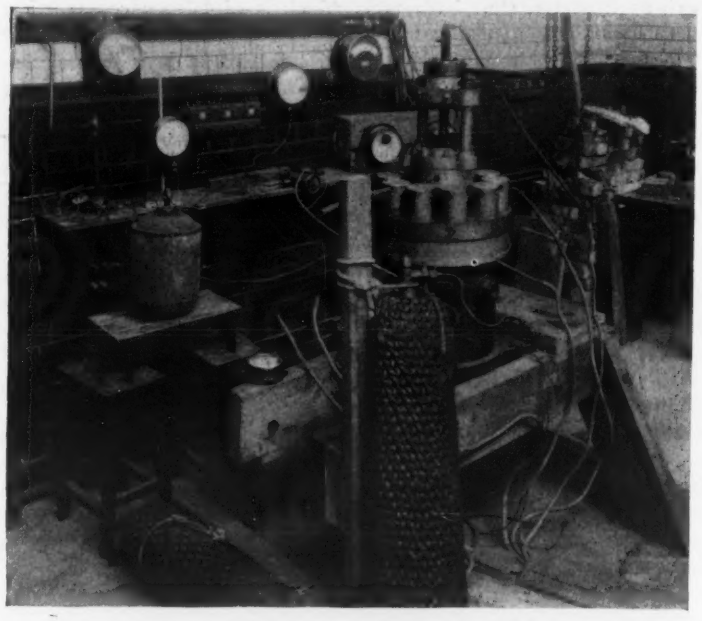


FIG. 7.—HIGH-PRESSURE ELECTRIC FURNACE.

Electrical Manufacture of Steel in Sweden.

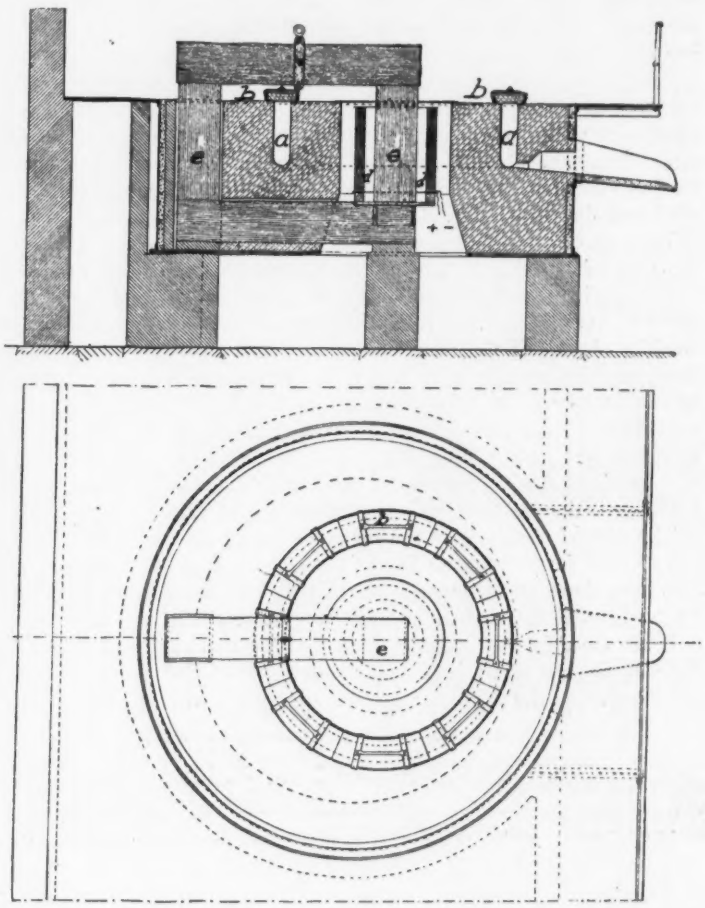
BY G. LINDMAN.

THE idea of making steel electrically is not new. In 1879 C. W. Siemens designed for this purpose an electric arc lamp furnace, in which the arc was formed between coal and the metal contained in a crucible of graphite as electrodes. This scheme had several disadvantages, for the steel was heated irregularly—too much near the arc and too little in the opposite end—and became impure from contact with the coal electrode; the carbonic acid received at the oxidation of the latter made it more difficult for the steel to get rid of absorbed carbonic acid and at the same time the consumption of the electrode has a great influence on the cost.

A more equal heating of the steel is obtained if a strong current passes through it, the resistance of the metal generating the heat. One has to work with a large current because the resistance of the metal is so small, and as a consequence one has to give the copper conduits at least the same area as that of the steel band. Dr. De Laval, of Sweden, tried to decrease this disadvantage by passing the current through a layer of slag, the resistance of which is considerably more than that of iron. The greatest difficulty with such furnaces is in relation to the electrode, because the coal electrode produces by its great resistance a considerable potential drop and at the same time is soon consumed.

To avoid these disadvantages, Mr. Kjellin, of Sweden, in 1899, invented an electric furnace without electrodes, which scheme was immediately carried out by Mr. Benedicks, director of several iron works at Gysinge, Sweden. The accompanying illustration shows the principle of the construction of the furnace.

A circular channel, *a a*, is the "fireplace," the bottom and sides of which are fireproof brick walls. At the top the furnace is covered with the lids, *b b*. In the middle of the circle is a core, *c*, of square section made of thin, soft sheet-iron plates and surrounded by a coil, *d d*, of insulated copper wire. The core is continued outside the "fireplace" and forms a rectangle, which is related to the fireplace as one link of a chain to another. The coil, *d d*, is connected to the poles of an alternating current generator.



ELEVATION AND PLAN OF FURNACE.

The whole construction can be considered as a transformer with its secondary coil short-circuited. The secondary consists of the

metal in the fireplace. Since this forms only one turn around the core, the current in it is approximately equal to that delivered by the generator multiplied by the number of turns of coil, *dd*. The potential, of course, decreases when the current increases. In this way it is possible to use a high-potential alternator and obtain a low-potential strong current without using energy consuming electrodes and heavy copper conduits.

In February, 1900, the first steel furnace was ready and experiments were made. The first tapping was made March 18, and the steel was of excellent quality. The problem was solved technically, but not economically, for with a dynamo of 78 kw not more than 270 kg of steel were obtained in 24 hours, and the furnace contained only 80 kg. Several furnaces have since been built, giving better results each time. The latest plant has a turbine of 300 hp, direct connected to a generator. The furnace holds 1,800 kg, and the production is figured to be 1,500 tons per year, charging with cold raw material.

The potential of the generator is 3,000 volts, thus decreasing the size of the copper conductors, and the operation has proved to be very satisfactory, the coil being in a well protected position.

The operation at Gysinge, where the best quality of steel for tool making is produced, is as follows:

After a tapping, when a little more than half of the metal is taken out, the furnace is charged first with cast iron pieces and then with case-shot, as much as experience shows to be suitable in order to get from cast iron, whose quantity of carbon has decreased, steel of desired carbon content. When everything has melted and is sufficiently heated, some manganese iron is added and the heating is continued for half an hour. The steel is then ready for tapping, which is done through a hole in the brick wall just as in the case of a common Martin furnace.

The steel resulting is of a superior quality and is distinguished by its strength, solidity, uniformity, toughness and ease of working in cold, unhardened condition, even with a very high percentage of carbon, at the same time being less liable to crack or warp in the hardening. The superiority of the steel compared with other steel, especially with respect to its softness in unhardened condition, lies in its freedom from gases, particularly hydrogen gas, resulting upon the fact that the steel during its melting is not subjected to the presence of burning gases of any kind. The manufacturing of special steel with nickel, chrome, manganese or wolfram is not beset with any difficulties. For making of permanent magnets the wolfram steel produced at Gysinge has proved to be better than other wolfram steel and does not, like the latter, warp in the hardening.

The cost of manufacturing by this process depends principally upon the cost of power. It has been estimated that the new furnace at Gysinge will give, using cold, raw material, 29 kg steel per electric horse-power per day, or 8,700 kg per horse-power per year of 300 working days. If the iron is instead taken melted to the furnace, the quantities become 64 kg and 19,200 kg per horse-power. In order to obtain low cost, it is necessary to build large furnaces, which necessitates large power plants. At a price of 75 kronor ($1.00 = 3.70 kr.) per year and electric horse-power, the cost for the power will be about 8.6 kr. per ton of steel with cold material, and 3.9 kr. using melted iron, figuring about 300 working days a year.

The cost of rewalling of the furnaces is considered to be 2.6 kr. per ton of steel for a furnace of 600 hp when the process is carried on as has been done at Gysinge. The cost of erecting such a furnace is 15,000 kr., the most of which goes for the electrical equipment.

From these figures it can be seen that the small and easily handled furnace in use at Gysinge can compete with other steel producing processes, especially since it gives a superior quality of steel.

Cheap Power from Culm.

Mr. Thomas H. Watkins, of Scranton, Pa., proposes to supply New York with electricity by utilizing the waste products of anthracite coal. His plan is to erect electric generating plants in the heart of the anthracite district and convey the power to New York by high-potential aerial transmission circuits. The project has passed the experimental period and is already well-defined and elaborated. Mr. Watkins is in a position to command almost unlimited capital. He has already employed a commission consisting of electrical engineers to pass upon the project and to advise him as to its practicability. At the head of this commission is Mr. L. B. Stillwell, who has pronounced himself as favorably impressed with the plan.

A Norwegian Water Power Plant.

By Franz Köster.

An interesting water power electrical generating plant has recently been completed at Hafslund, about 56 miles southeast of Christiania, the principal city of Norway, and near the little town, Sarpsborg. The plant was designed by the Elektrizitäts-Aktiengesellschaft, vormals Schuckert & Co., of Nuremberg, Germany, and will ultimately supply 25,000 hp for lighting and power distribution. Part of its output is transmitted to the city of Fredrickstadt, about 9½ miles distant, another portion has been contracted for by a carbide manufactory, located near the power plant, and provision is made to supply current for electric traction, to be used on a branch of the railroad, "Christiania-Ausland," running to the harbor of Sandesund.

The main source of power is the waterfall, Sarpsfoss, in the River Glommen, the largest in Norway. The total fall is about 59 ft., with a minimum supply of from 3,500 to 4,200 cubic ft. per second; but by damming the water of Lake Mjösen, which is located some distance above the fall, a constant supply of about 10,500 cubic ft. per second is made available. This was necessary, as at times, at changes of the season, the flow of the Glommen is greatly augmented, while at other times its volume is insufficient for the purpose. Allowance was made for the water already used for industrial purposes and the plant was designed for a steady supply of 4,600 cubic ft. per second.

The construction of the entire canal, basin and other portions of the hydraulic equipment was completed simultaneously with the erection of the first portion of the power plant, one-third of the entire structure. This first division has been in operation since 1899; the second is now being finished and the third will soon be begun. The whole canal and basin had to be blasted out of solid granite, as well as the site of the power house. The construction of the canal was accompanied by other difficulties, the protecting dams being once washed away by an unexpected torrent. The location of the power house was such that no dam could be effectively constructed to protect that portion of the work which had to be prosecuted only when the water was very low, the foundations being submerged during the greater part of the year.

A general plan, showing the location of the power house first finished, is given in Fig. 1. The water from the river enters a canal starting about 380 ft. from the plant. This canal is 33 ft. wide at the bottom, has a 5 per cent. pitch, and ends in a basin. In the canal is a rack as shown in Fig. 1, marked "A," and in detail in Figs. 6 and 7. The object of the rack is to arrest all floating material such as logs, ice, etc. This rack, which is of I-beam construction, is 28 ft. in length, resting on the bottom of the canal at an angle of about 40°. It is hinged on an I-beam and an arch-shaped concrete construction which spans the canal and protects the inner basin.

In the event of high water the rack is lowered in order to prevent too great a flow of water and to catch any logs, ice blocks or branches of trees that may come down. At the usual level timber is floated down the Glommen and caught at a station above the canal, and floated through a channel parallel to the canal and to saw mills immediately south of the power house. These mills have turbines of their own, but these are no longer wholly used, since the erection of the second portion of the power plant.

The difference in level between high water in the canal and in the basin varies from 10 to 13 ft. and is regulated by the rack, *A*, the lock shutter, *B*, and the sluice gate, *C*.

The floor of the basin below the rack is a step higher than the floor under the rack. This step runs diagonally across and where it reaches the north side of the wall there is an aperture through which all sand, rocks and other matter sweeping along the bottom of the canal are expelled, which otherwise would be carried on to the screen.

Originally the turbines of the mills were supplied by a canal which now shows in the plan as a "blind alley." A small triangular abutment will be noticed above the rack. This was subsequently built to deflect timber over the north wall of the canal at high water, as timber showed a disposition to collect at the inner corner of the rack.

At *D* is a sluice gate through which the ice naturally forming in the basin is gotten rid of. When any repairs have to be made or when it becomes necessary to clean the basin, the water is drained

off through this gate, the lock-shutter at *B* being closed and the flow going through the sluice gate, *C*. All these gates are operated both by hand and by electric motors, the motors being used particularly when quick work is desired or when the gates are to be fully opened. Over the gates are small houses and between *D* and *B* above the overflow wall of the basin, is a bridge. Access is also had to the house over C across the concrete arch below *A*. The top of the overflow wall of the basin is 5 ft. lower than the south wall and the fall over this, the overflow wall, is about 70 ft.

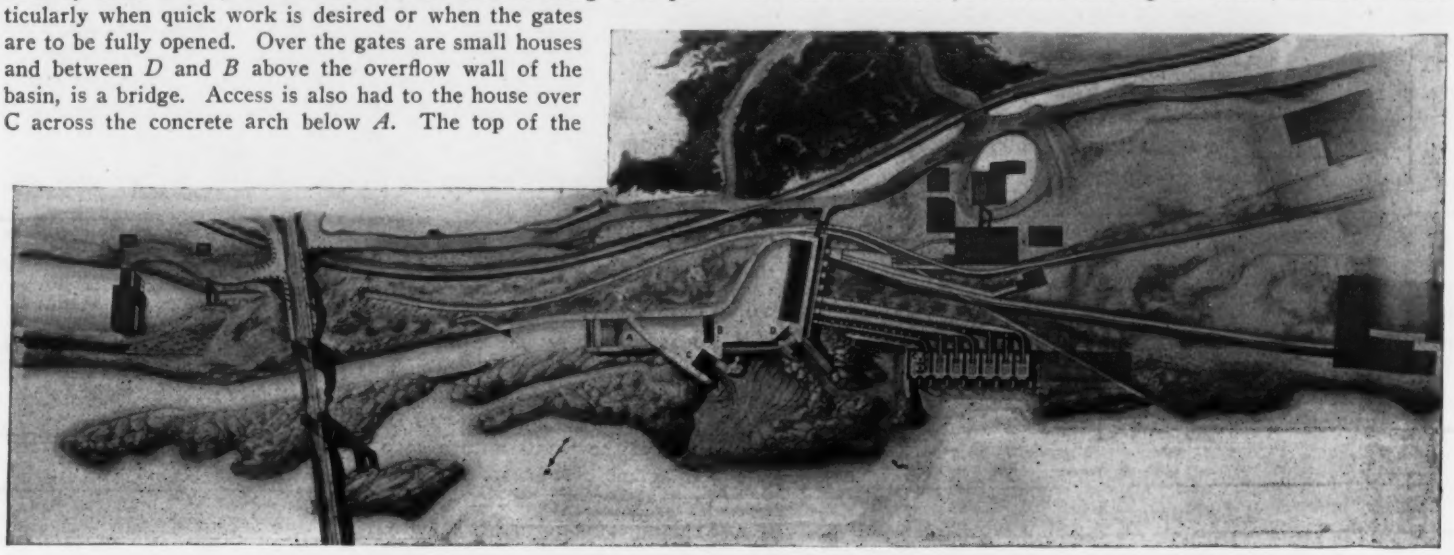
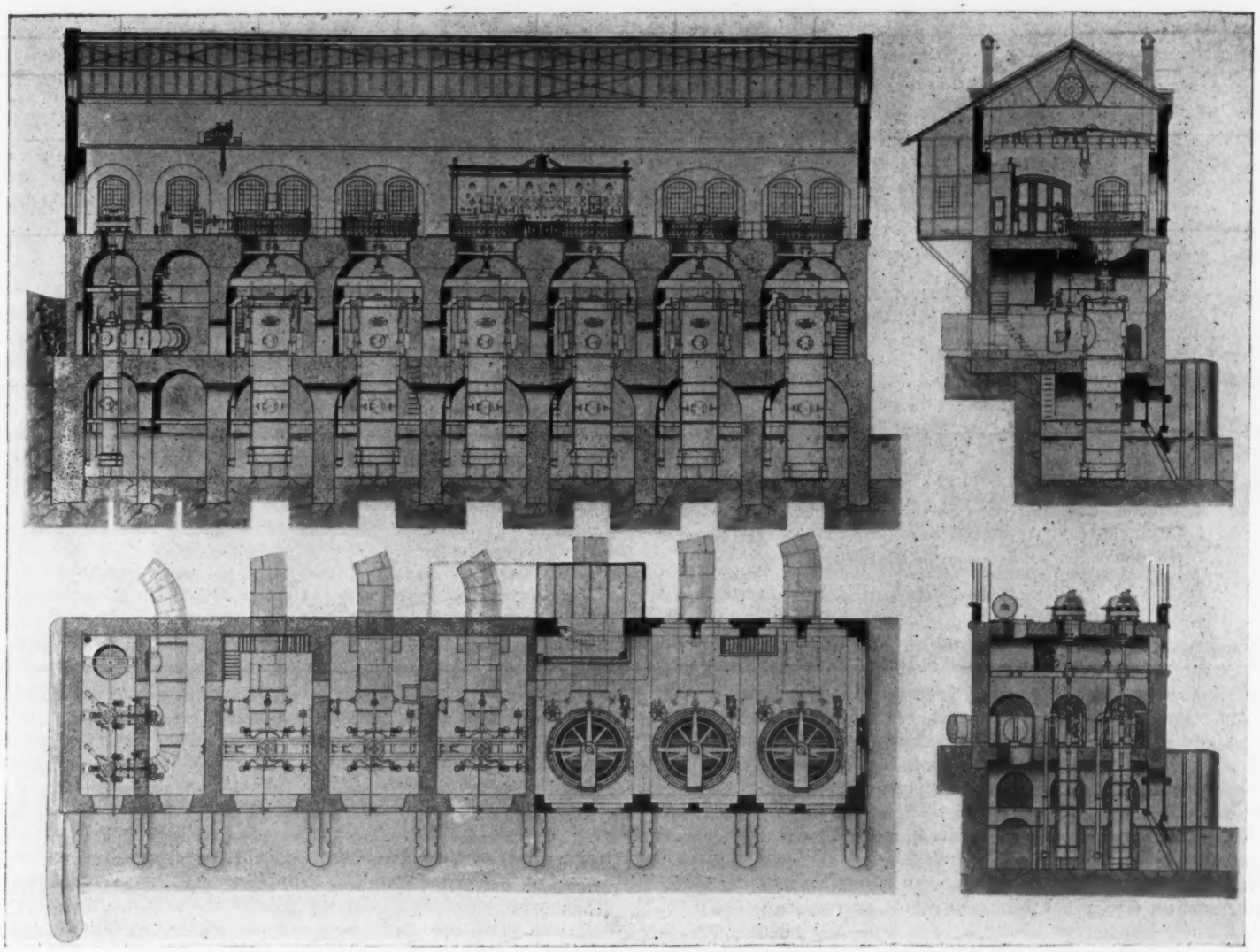


Fig. 1.—General Plan of Water Power Plant at Hafslund, Norway.

The dam wall of this basin is constructed with seven chambers, from which the water runs through seven pipes to the turbines. These chambers are protected by fine screens of flat iron. The pipes can be closed independently. The first pipe, counting from the overflow wall, is 6½ ft. in diameter. At the power house this flow is used to operate the direct-current exciter dynamos. It will ultimately have three branches, only two of which are now finished. The remaining six pipes are 10 ft. in diameter each, and the two which lead to the first portion of the power house, divide into three branches just before entering the house; a throttle valve being placed in each tube inside the power house to cut off the turbines when necessary.

The power house—that is, the portion first completed—is shown in plan in Fig. 4; in longitudinal section in Fig. 2; Fig. 3 a cross-section of the main turbines, and Fig. 5 a cross-section of the turbo-exciter room. The building is 147 ft. long, 36 ft. wide and divided into 8 chambers, each 16 ft. wide, with the exception of two, which are only 10 ft. Grooves will be noticed in the abutments. Into these planking is fitted when it is desired to shut out the tail water,



Figs. 2, 3, 4 and 5.—Plan and Sections of Hafslund Power House.

and the space is filled with a good quality of horse manure well tamped down, the water inside then being pumped out. To prevent the tail water and ice from backing in too suddenly, a flap gate the length of the distance between the abutments and about 5 ft. wide swings down against I-beams placed for the purpose.

The main or dynamo floor is about 37 ft. above tail water at low water level. The turbines are of the Jonval type, with vertical shafts, and develop 1,200 hp at 143 r.p.m., with a fall of 54 ft.; or 1,400 hp with a fall of 59 ft. The six main turbines are

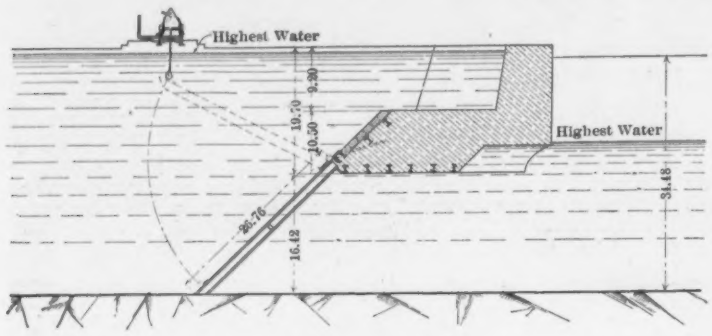


FIG. 6.—DETAIL OF RACK.

regulated by sleeves on the bottom of the draft tubes, which are worked by means of electric governors. The dynamos are three-phase, 5,000-volt generators, developing 865 kw. The two direct-current 200-kw exciter dynamos are coupled with turbines which develop 280 hp at 280 r.p.m. These turbines are regulated by sleeves similar to those regulating the larger turbines, except that the governor is mechanical instead of electrical. One of these turbo-exciters

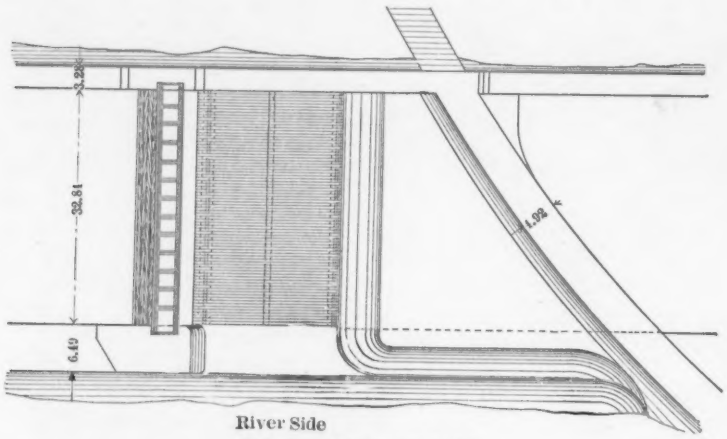


FIG. 7.—DETAIL OF RACK.

is ample to do the work, the other being held in reserve. Provision is made for feeding the trolley of the branch line referred to by reducing the voltage from 5,000 to 600.

The four turbines in the second portion of the power house, which are of the Francis type, are of 2,050 hp each. When the three portions of the power house are completed the total output will, as stated, exceed 25,000 hp.

Marconi News for England.

A London dispatch of March 30 says: "The *Times* publishes two messages of over 100 words from its New York correspondent, giving items of American news sent from America by the Marconi wireless system. In an editorial article the *Times* says these messages mark the establishment for the first time of the regular commercial transmission of news by the Marconi Company. The paper announces that the day-by-day transmission of news between the New and Old Worlds by the Marconi system has been undertaken for the *Times* upon a contract basis. It says this marks an epoch in the development of telegraphy. It is added that messages can be sent between England and America by the new system at a rate not much in excess of that for messages between England and France by the old system." This ought to put a stop to the silly slanders in circulation, to the effect that Mr. Marconi has never sent even signals across the Atlantic.

Electroculture.

By Emile Guarini.

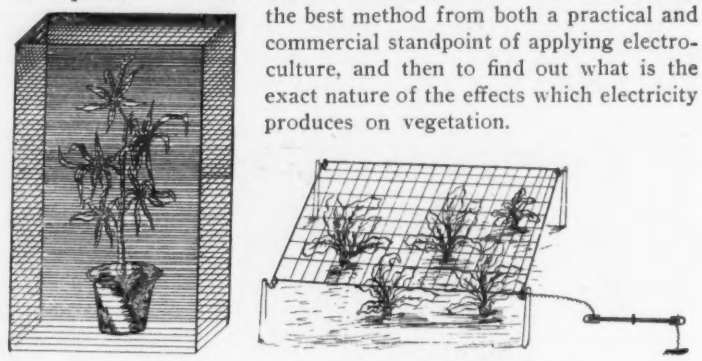
THE researches concerning the influence of electricity on vegetation had their origin at the same time, it may be said, as the science of electricity itself, dating back a century and a half. The name of M. Sélim Lemstroem, professor of physics at the University of Helsingfors, is closely associated with this history through the great number of articles which he has published on electroculture since 1885.

We shall not take up his early experiments nor the studies which the learned Russian professor made on this subject in 1886, but examine successively his more recent experiments. I mean those which took place from 1898 to 1901, and the results of which have been recently communicated.

The influence of electricity on vegetation is now a fact well known to science. Should this be contested, reference may be made to the experiments of Grandeau and Leclercq. These two investigators surrounded the plants with a cage of wire (Fig. 1) so as to prevent the action of atmospheric electricity. By this means they found that a very harmful influence was brought to bear on vegetation.

Grandeau reports that when the electricity of the air has free access it produces an increase in the crops of from 50 per cent. to 70 per cent. in the leaves and stems and from 50 per cent. to 60 per cent. in the seeds and fruits.

The question once decided, there remains to be determined, first, the best method from both a practical and commercial standpoint of applying electroculture, and then to find out what is the exact nature of the effects which electricity produces on vegetation.



FIGS. 1 AND 2.—ELECTROCULTURE.

The experiments of M. Lemstroem have no bearing on the first question, but on the second they furnish very interesting and probable explanations, although they do not seem, as yet, quite complete. The first investigations of the learned professor established that negative electricity is better for plant than the positive. They had also the purpose to determine whether the action of electricity was independent of the latitude under which the experiment takes place; whether heat is injurious to the treatment of plants by electricity; and, lastly, whether the vigor of the plants and the fertility of the soil have an important bearing on the crops submitted to electrical treatment. The actual experiments have had for an object to solve the following questions:

1. Which hour of the 24 in the day is the most favorable to apply electricity? Is the latter effected by the time during which it is employed?

2. In what proportions are the plants submitted to this treatment actually increased?

3. Of what does the influence of electricity upon plants consist?

In all these experiments he used the current furnished by an electrostatic machine of his own invention. This new machine was considered superior to any of the older types in as much as for the same amount of work it furnishes three or four times more electricity; because it is possible to accelerate very considerably its rotation and therefore to charge a great deal larger surface of wire. Besides this, it is not as easily affected by humidity as the older machines, and can work three or four months without very much cleaning.

The cylinders used in its construction are about 30 cm in diameter and about 40 cm in length. The cylinder used in the interior is smallest in diameter and not quite as long. The machine worked generally from 4 o'clock in the morning to about 7 or 11 o'clock, and from 4 in the afternoon to 8 in the evening. A complete uniformity, however, could not be maintained, for during wet or rainy days the

machine could not work. But on the other hand it worked longer when the sky was cloudy.

The metallic circuit attached to the machine was placed around the fields in the following manner (Fig. 2): A galvanized wire of 1.5 mm thickness was placed on supports around the fields. On this wire there were stretched transversely and horizontally other wires of 0.5 mm at a distance of 1.25 metres from each other. This wire was fixed to these supports by means of ebonite isolators well protected and invented for the purpose by the author of the experiments.

The length of the sparks between the discharging spheres of the machine was measured at the time it was started and when the movement was stopped, and sometimes also in the intervals. They generally greatly varied.

The length of the sparks is measured by the potential at which the circuit may be charged. It depends upon the external meteorological conditions, among which the degree of humidity of the air is the most important factor. The potential of the circuit of a given machine is weaker as the electricity escapes more rapidly. Thus the electricity meets a smaller resistance in the layer of air between the circuit and the plants. The resistance is greater during the day, when the air is drier, than during the night, when there is a great deal more humidity. The electrical current which goes from the circuit to the plants is, therefore, slightly different during the day from what it is in the night, and besides there exist radical differences in the life of the plants during the day and the night. It is for these reasons that in 1900 M. Lemstroem reserved the electrical current especially for the night.

The great difficulty to overcome in all experiments of this kind is found in the fact that the fertility of the ground cultivated is very uneven, even when the plots are very small and very near each other. M. Lemstroem tried to eliminate this factor without, nevertheless, ever completely succeeding.

In his experiments of 1898 the electrical machine worked from

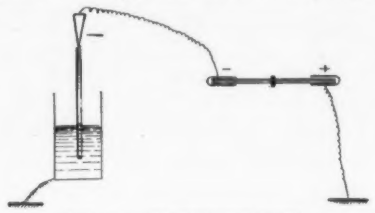


FIG. 3.—ELECTROCULTURE.

5 to 9 in the morning and from 4 to 8 in the evening. After 164 hours of treatment the plants in the tobacco field used for experiments and those in the field used for comparison, showed a marked improvement in the favor of the first one. The increase in the crops were 39 per cent. for tobacco, of 8.7 per cent. for carrots, 11.2 per cent. for beets and of 11.1 per cent. for lima beans.

In 1899 care was taken to classify the plots according to their respective fertility and to increase the number of plots used for experiments and those used for culture in order to obtain average results as exact as possible.

Nevertheless, on account of the insufficient preparation of the ground and the late season in which the seeds were sown, the crops were inferior to those resulting from the experiments preceding. The electrical machine worked as regularly as possible and the sprinkling was carried on with great care. Following were the results: Oats showed an increase of 28.7 per cent.; barley, 23 per cent.; carrots, 37.5 per cent., and potatoes, 50 per cent. Peas showed a decrease of about 7.5 per cent., and cabbages 19.1 per cent.

If the unfavorable circumstances under which the experiments were conducted are taken into account the results were equal to those of 1898.

In his attempts of 1900, M. Lemstroem purposed, as we have already said, especially to look into the effects of electricity on the plants during the night. But since the increase may be attributed to the greater length of the treatment during the previous season of 1899, the results do not prove any specific fact as to the relative values of the treatment during the day and during the night.

The increase obtained in 1900 was very high, being about 26.4 per cent. for barley, 55.7 per cent. for peas, 17 per cent. for potatoes, 88.7 per cent. for strawberries, 92.7 per cent. for carrots, and 33.3 per cent. for lima beans. Moreover, the average of the first crops of the experimental fields surpassed the average of the first experiments in the ordinary fields, which gives the first ones a far more rapid development.

The trials on the cereals in 1899 showed that the germination of wheat as well as of rye was far more prompt. The plants were more vigorous, and the crops of a better quality. In fact, the increase of the wheat was 26.9 per cent. for the first quality, the total increase being 15.8 per cent. For the rye it was of 32.1 per cent. for the first quality and 28.4 per cent. for the whole crop.

Judging from the results obtained, M. Lemstroem infers that, since the increase is greater when the electricity acts both day and night, there must exist some ratio between the time of treatment and the proportion of increase. As to whether there is also some bearing between these last proportions and the length of treatment, that he is not able to decide as yet. He thinks, on the other hand, that it is possible that the difference of potential and of resistance might be such that the current was constant. But what is more probable is that the current undergoes great variations, and that the relations between the application and the increase must vary, and it follows that the action of the current on the plants must be modified by external causes.

But what is the exact action of electricity on plants? The author has taken pains to discover it by a few experiments in the laboratory. By plunging (Fig. 3) a capillary tube in the water of a vase placed in communication with the ground and placing a metallic point in close communication with the negative pole of an influence machine, there is formed, after the machine is worked a few moments, small drops of water in the upper part of the tube. In order that the experiment may succeed, however, it is necessary to wet the inside of the tube, and the positive pole of the machine should communicate with the ground. Under these conditions the water goes up the sides of the tube and forms one or several drops of liquid. The quantity of water that thus rises is in direct proportion to the strength of the current and inversely as the square of the distance of the plant to the level of water in the tube.

The quantity of water also depends upon the length and the diameter of the tube as well as on the resistance which the current meets. Thus a current of electricity is produced attracting the liquid in the positive direction.

Comparing these phenomena with his experiments in agriculture, the author deduces the following conclusion: "The current produced by the influence machine whose positive pole is grounded "goes from the earth through the plants towards the points of the "isolated circuit, and from there to the negative pole of the machine. "This causes the ascension of the liquids, that is to say of the sap, in "the capillary tubes of plants. In this manner an increase in the "energy is produced to which is due the circulation of the sap."

M. Lemstroem found that there were produced at times in his machine an inversion of the poles which had for effect to charge the circuit less often with positive electricity than with negative electricity.

He then made some new experiments in which the direction of currents was submitted to very close regulation. With this end in view, he placed twelve pots in four series, the pots containing the same kind of seeds. Above the sections 1, 2, 3 was suspended a circuit of iron wire fitted with points.

Bands of zinc were passed from the bottom of the pots, which were placed on saucers of clay supported by panes of glass with supports of ebonite. In section 4 were pots without electrical connections.

The negative pole communicated in the first section with the bands of zinc; in the second section with the upper circuit and the third section with an insulated commutator making it possible to establish a communication alternatively with the bands and the circuits and respectively to place, as desired, the circuit or the band in communication with the soil. The cereals and the strawberry plants showed an increase which went as high as 60 per cent. in section 1; for the carrots the proportional increase was 182.7 per cent. in section 1, 32.4 per cent. in section 2, and 13.2 per cent. in section 3.

The positive current in section 1 thus gave a result very superior to the negative current. The electrical current of the air, besides aiding the ascension of the sap, therefore, increase also the development in a greater proportion, yet when it is produced in an inverse direction.

M. Lemstroem concludes that the negative current aids the ascension of water and increases in this manner the circulation of the sap. The positive current brings to the plant the different elements of

the atmosphere and circulates them through the capillary tubes present, to undergo there a process of assimilation.

From these series of experiments the learned professor thinks he is justified in offering the following propositions:

a. The proportion in which the plants were increased may be estimated at 45 per cent.

b. This proportion relates to the nature of the soil.

c. Certain plants only bear the electrical treatment when they are well watered. Their increase in duction is then very remarkable.

d. The electrical treatment is injurious during solar heat; it therefore should be discontinued in the middle of the day.

e. Different methods are necessary to produce overproduction.

The question of the influence exercised by an artificially created electrical air current cannot be considered definitely solved. M. Lemstroem is the first one to recognize that. Nevertheless, experiment has furnished a plausible explanation, based on exact facts, as to how this influence is exercised.

Annual Report of the Bell Telephone System.

In the annual report of the American Telephone & Telegraph Company for the year ended December 31, given below, President Fish remarks that there is scarcely a section of the country where the supply of telephone facilities equals the demand. The report shows an increase in earnings from dividends received of $1,035,315, from telephone traffic of $66,262 and from interest of $299,237. Gross earnings reached the large sum of $13,277,457, an increase over the previous year of $1,670,640. Expenses, however, increased $1,233,654, which left a gain in net earnings of $436,986. In consequence of new issues of stock dividends paid increased $1,534,380, hence the balance after dividends decreased $1,097,394 from the previous year. The amount carried to reserve was much smaller than in 1901, say $522,245, against $1,377,650; and the final surplus was $728,623, a decrease of $241,989.

The detailed report covering the operations for the fiscal year ended December 31 shows:

Earnings:	1902.	1901.	Increase.
Dividends	$6,023,523	$4,988,208	$1,035,315
Rents of instruments	2,299,378	2,647,908	*348,530
Telephone traffic	4,199,709	3,533,447	666,262
Real estate	56,031	36,680	19,351
Interest	698,816	399,579	299,237
Miscellaneous	.....	995	*995
Total earnings	$13,277,457	$11,606,817	$1,670,640
Expenses:			
Admin. expenses	$964,827	$772,424	$192,403
Interest and taxes	1,970,948	1,276,559	694,389
Legal expenses	124,646	99,139	25,507
Telephone traffic	2,381,764	2,060,409	321,355
Total expenses	$5,442,185	$4,208,531	$1,233,654
Net earnings	$7,835,272	$7,398,286	$436,986
Dividends paid	6,584,404	5,050,024	1,534,380
Balance	$1,250,868	$2,348,262	*$1,097,394
Carried to reserve	522,245	1,377,650	*855,405
Surplus	$728,623	$970,612	*$241,989

* Decrease.

The balance sheet as of December 31 is as follows:

Assets:	1902.	1901.
Construction, equipment and surplus	$22,496,191	$19,116,200
Telephones	6,522,106	5,113,408
Real estate	1,745,280	1,665,598
Stocks and bonds	114,864,798	84,339,912
Patent account	166,014	150,000
Machinery and tools	48,126	35,987
Cash and deposits	6,933,364	1,694,342
Bills and accounts receivable	15,528,621	10,972,535
American Bell Telephone Co.	22,110,400	22,110,400
Total	$190,414,903	$145,198,394
Liabilities:		
Capital stock	$114,946,500	$104,650,600
Capital installments	11,172,472	.....
Surplus	3,493,290	2,764,668
Bonds	28,000,000	15,004,500
Reserves	6,079,262	4,047,476
Accounts payable	*8,078,168	2,760,938
Contingent	18,645,210	15,970,210
Total	$190,414,903	$145,198,394

* Of this amount $1,976,312 is for dividend payable January, 1903.

Comparative statistics from the reports of the past three years are as follows:

	1902.	1901.	1900.
Telephones, Dec. 20	3,150,320	2,525,606	1,952,412
Exchanges, Jan. 1	1,514	1,411	1,348
Branch offices	1,861	1,594	1,427
Miles wire underground	1,328,685	883,679	705,269
Miles wire marine	6,048	4,200	4,203
Total miles wire	2,443,750	1,729,019	1,354,209
Number of circuits	724,654	592,467	508,262
Number of employees	50,350	40,864	32,837
Number of stations	1,277,983	1,020,647	800,880
Number of daily connections	9,322,951	7,719,139	5,668,986

President Fish remarks: "The total amount added to construction and real estate by all the companies constituting our system during 1902 was:

For exchanges	$26,014,800
For toll lines	8,282,900
For land and buildings	3,038,800
Total	$37,336,500

"The amount added in 1900 was $31,619,100; in 1901, $31,005,400.

"The expenditures in 1902 for the construction, equipment and supplies required for its long-distance lines was $3,379,982, making the total investment in long-distance lines and equipment to the close of the year $22,196,191.

"There is hardly a section of the country where the supply of telephone facilities equals the demand. During the past year the operating companies have made larger gains in their subscribers than in any previous year. The estimate for the coming year merely for new circuits on the now existing long-distance lines calls for an amount equal to about 10 per cent. of the entire investment made to date on the company's long-distance plant.

"During the past year the company received from the issue of new stock offered at par to its stockholders the sum of $21,226,122; $9,965,550 of this amount was received in January, 1902, and $11,260,572 in September, 1902. The balance of the proceeds of the latter issue was received in January, 1903. Further stock issues will undoubtedly be necessary in the future.

"At present about 55 per cent. of the entire mileage of wires used for exchange service throughout the country is underground.

"Since the last report there has developed a recognition on the part of many of the competing telephone companies that the rates generally adopted by them were much too low. The public will be educated to a recognition of what are proper and reasonable rates for telephone service, in which event our companies will be in a position to relieve themselves of what is substantially the only ill effect that has followed from competition, namely, the reduction in certain localities of the rates charged to subscribers to a point which allowed no profit, and in some cases involved a loss.

"If a reduction in metals had not been made the amount carried to surplus on the books of this company for the year 1902 would have been substantially greater."

The directors of the American Telephone & Telegraph Company were re-elected at the annual meeting of stockholders on March 31. The personnel of the board is as follows: Charles W. Amory, Francis Blake, George L. Beardsley, T. Jefferson Coolidge, Jr., Frederick T. Fish, Henry F. Howe, Charles E. Perkins, Nathaniel Thayer, John I. Waterbury, George F. Baker, Charles T. Bowditch, Alexander Cochrane, W. Murray Crane, J. Malcolm Forbes, Charles Eustis Hubbard, Thomas Sanders, Theodore N. Vail, Moses Williams.

President Fish emphatically denied the report that has been repeatedly circulated to the effect that the new stock would be used for purchasing a controlling interest in the Western Union Telegraph Company. Mr. Fish says: "The Western Union report is all nonsense."

At the special meeting of the American Telephone & Telegraph Company, 968,735 shares out of a total of 1,500,000 were voted in favor of increasing the capital stock from $150,000,000 to $250,000,000. There was no opposition. President Fish stated at the special meeting that the increase has been made so that the directors will have the power to issue it as the occasion may require during the next few years. He also stated that of the $150,000,000 previously authorized only $135,000,000 had been issued.

March Meeting of the American Institute of Electrical Engineers.

The attendance Friday, March 27, at the monthly meeting of the American Institute of Electrical Engineers was larger than usual, doubtless owing to the interest of the topic to be discussed, "High-Tension Transmission." The dinner which preceded the meeting was also unusually well attended, more than sixty members being present. Secretary Pope announced that at a meeting of the Board of Directors in the afternoon, the following nominations of officers were made: President, B. J. Arnold; vice-presidents, Calvin W. Rice, W. S. Barstow and Ralph D. Mershon; managers, Dr. Samuel Sheldon, W. C. L. Eglin, George F. Sever and A. H. Armstrong; treasurer, George A. Hamilton; secretary, Ralph W. Pope. It was also announced that 200 associate members were elected at the afternoon meeting, and that more than that number of applications are awaiting action.

An important action of the Board of Directors was the establishment of a grade of membership to be known as "Students of the American Institute of Electrical Engineers." These students will not be corporate members of the Institute, owing to the fact that the Constitution limits such members to those in the grades of member, associate member and honorary member.

In introducing the topic of the evening, President Scott spoke of the steady advance made during the past ten or twelve years in electrical transmission of power at high tensions, and gave illustrations from the statistics of one of the large manufacturing companies. Units recently built have three times the output of the largest transformers of five years ago, and the aggregate output has been over a million kilowatts. The average kilowatt output per month during the last year is equal to the total output during the past seven years, and the output of the past two years has exceeded that of the preceding ten years.

The discussions of the evening were participated in by Messrs. W. N. Smith, P. H. Thomas, R. D. Mershon, P. M. Lincoln, T. A. W. Shock, F. M. Waterman, C. C. Chesney, W. L. Waters C. E. Skinner, C. O. Mailloux, H. W. Buck, C. L. De Muralt and Philip Torchio.

The first paper presented was one by Mr. Ralph D. Mershon entitled "Mechanical specifications for a Proposed Standard Insulator Pin." After setting forth the theoretical considerations which should guide in fixing the dimensions of the standard insulation pin, the following specifications were given:

Threaded End.—It is proposed to make the diameter of the small end of the pin 1 in.; the length of the threaded portion 2½ in., and the diameter at the lower end of the threaded portion 1.25 in., so that the threaded portion will taper from 1.25 in. to 1 in. in a length of 2½ in. The threaded portion of the insulator should have the same dimensions and taper as that of the pin.

Shoulder.—It is proposed to make the shoulder 3-16 in. on all pins. That is, the diameter of the pin just above the cross arm will be ⅜ in. greater than the nominal diameter of that portion of the pin in the cross arm; it is proposed to carry this diameter ¼ in. above the cross arm before tapering the pin.

Dimensions in Cross Arm.—It is proposed to make the diameter of that portion of the pin in the cross arm, just below the shoulder, 1-32 in. less than the diameter of the hole in the cross arm and at

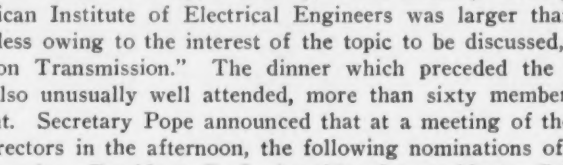


FIG. 1.—FORM OF THREAD.

the lower end of the pin 1-16 less than the diameter of the hole in the cross arm. It is proposed, also, to designate this portion of the pin as having a nominal diameter equal to that of the hole in the cross arm into which the pin fits. Therefore, that portion of a pin which is to fit a 1½-in. hole in a cross arm will have a nominal diameter of 1½ in., but will have an actual diameter just below the shoulder of 1 15-32 in., and at the lower end of the pin of 1 7-16 in.

Thread.—It is proposed to use on all pins a thread having a pitch of ¼ in. or 4 threads to the inch, the form of thread to be that shown in Fig. 1 (scale four times full size). As there shown, the angle between the faces of the thread is 90° and the top of the thread is flattened by cutting off, from the form the thread would have if not flattened, one-fourth its unflattened depth. The form of the thread in the insulator should be the same as that on the pin. If this is done it will insure the bearing surface being always on the sides of the threads and never on the edges.

Designation.—It is proposed to designate that portion of the pin above the cross arm as the "stem" of the pin. That portion in the cross arm as the "shank" of the pin. It is proposed to designate a pin by the length of its stem, i. e., a pin whose stem is 5 in. long will be designated as a "5"-in. pin, one 6 in. long as a "6"-in. pin, etc.

Dimensions of Standard Pins.—In accordance with the above the following table has been prepared, giving a number of sizes of pins, and their dimensions, which it is proposed to make standard. The

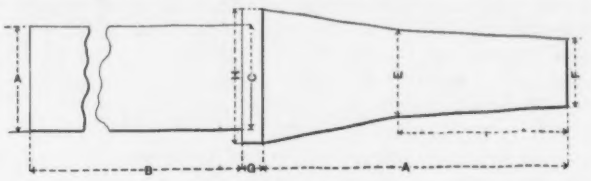


FIG. 2.—STANDARD PIN.

diameter of the shank has in each case been fixed by making it approximately equal to (slightly larger than) the diameter of the theoretical pin corresponding to the length of the stem of the pin in question. The headings of the columns of the table refer to the lettering of Fig. 2. Fig. 2 is a dimensioned unthreaded 5-in. (proposed standard) pin.

Size of Pin.	A	B	C Nominal.	C Actual	D	E	F	G	H	I
Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
5	5	4¼	1½	1 31/32	1 7/16	1¼	1	¾	1⅜	2½
7	7	4¼	1¾	1 31/32	1 7/8	Same for all sizes of pins.	Same for all sizes of pins.	Same for all sizes of pins.	2⅛	Same for all sizes of pins.
9	9	4¼	1⅜	1 31/32	1 7/8				2¼	
11	11	4¼	2	1 31/32	1 7/8				2⅜	
13	13	4¼	2⅛	2 3/32	2 1/16				2½	
15	15	4¼	2¼	2 3/32	2 1/16				2⅝	
17	17	5¼	2⅜	2 11/32	2 5/16				2¾	
19	19	5¼	2½	2 11/32	2 5/16				2⅞	

Following the presentation of his paper, Mr. Mershon, as chairman of the Committee on High-Tension Transmission, read several written communications on the subject. Mr. M. H. Gerry, Jr., of the Missouri River Power Company, favored a diameter greater than one inch at the top of the pin proposed by Mr. Mershon and a thread of greater length than 2½ in. Wooden pins most frequently fail by shearing, and a pin of larger diameter and a longer thread has an advantage in preventing the insulator from tipping out of line when the fitting is loose between the thread of the pin and that of the insulator. The shoulder suggested was criticised, the sharp corner of which introduces an element of weakness. Mr. Gerry suggested a shoulder which tapers at an angle of 60° and fits into a counter-bore in the top on the cross arm, thus giving a firm bearing which has the effect of steadying the pin and increasing the strength at that point. Instead of the form of thread proposed by Mr. Mershon, Mr. Gerry suggests a square top to the thread as wide as the groove; this form of thread may be easily and readily cut in either seasoned or unseasoned wood, and the depth not being so great, the pin is stronger at the bottom of the thread. Pins of the above construction have been used by the Missouri River Power Company with excellent results on a 50,000-volt line.

Mr. W. R. C. Corson gave the results of some tests in a Sellers machine to determine the fibre stress of pins in pounds per square inch. Six standard locust pins were tested supported in a 1½-in. hole in a hard wood block and the measured tension applied about 4½ in. from the block. The average value of the constant was 11,130 pounds per square inch, but the test showed that it is probably best to assume that for a maximum load this constant should not be greater than 9,000. In conclusion Mr. Corson said that the dimensions of the pin suggested by Mr. Mershon would prove to be of ample strength to withstand the side strains to which it may be subjected.

Prof. C. L. Corey also gave the results of some tests on pins, the purpose being to determine how near those in general use in Cali-

fornia conform to the proposed standard pin suggested by Mr. Mershon. The California pins do not exactly conform in size and length of stem with any of the proposed standard pins, but in general the dimensions of the proposed and tested pins agree fairly well. It seemed evident, however, that one inch is not a sufficient diameter for the thread of a pin for all sizes, and the shank was shown to be the weakest part in the 6⅞-in. pins, while the stem, and particularly the upper portion of the stem at the thread, was the weakest part of the 10⅛-in. pins. Prof. Corey stated that on the 33,000-volt, 83-mile, double-circuit, 3-phase transmission line of the Edison Electric Company from its Santa Ana power house to Los Angeles, iron pins with porcelain sleeves are used.

He considered an iron pin in many respects better than one of wood and described a pin of this kind designed by Mr. Wynn Meredith for use on the extensive lines of the Vancouver Power Company. This consists of a 12-in. steel bolt; a cast-iron sleeve 4¼ in. long fitting closely to the cross arm, fills the space between the thread and corresponds to the stem of the ordinary wooden pin. A lead thread is cast on the end of the steel bolt, the bolt first being chopped or made ragged to enable the lead to hold.

Mr. D. L. Huntington, electrical engineer of the Washington Power Company, Spokane, Wash., described some experiments with iron pins. As the result of these experiments, a pin was adopted 18 in. long, made of 1⅛-in. round, mild steel bar having a shoulder and shank cast upon it.

Mr. W. N. Smith did not see how a single standard table of dimensions for an insulator pin could be laid down to cover all the conditions of various power transmission lines, which ranged in size from No. 4 wire up to a 300,000-cm cable, such as is used at Niagara. He thought it would be well to have a tabulation for sizes of conductor from No. 6 to No. 3, another from No. 3 to 0, another from No. 3 to No. 4-0, and another from No. 4-0 up. Mr. Smith agreed with Mr. Gerry that the top of the proposed pin is rather small for the very heavy insulators required for transmission above 30,000 volts. Mr. P. H. Thomas thought that a shoulder should be arranged so that a pin will not go to the top of the insulator, for when a pin comes to a bearing at the top on the inside of an insulator, the expansion of the pin may crack off the top of the latter. Mr. Mershon in replying to the criticism by Mr. Gerry said that the reason given for having the top of a pin larger does not hold. If an insulator is properly designed it will not tip and if it does it is the fault of the insulator and not of the dimensions of the pin. The thread proposed by Mr. Gerry would have no greater shearing strength than the thread of the suggested standard pin, and as to up strain, a line should be so designed as to make this so slight that it would not have any particular bearing on the shearing strength of the pin. Mr. Mershon considered that if a standard were adopted and though changed from year to year, we could not be any worse off than we are now without any standard. At present the only way to get a pin to fit an insulator is to send the insulator to the pin manufacturer, or vice versa.

A paper presented by Mr. F. O. Blackwell, entitled "The Testing of Insulators," after dealing with some general considerations, gives instructions for the testing of insulators. He stated that since reliable transformers not excessive in cost can be made for twice the voltage that any line yet constructed will stand, the length of transmission lines is to a great extent limited by the insulator. He pointed out that the shape of the potential wave has a pronounced effect in breaking down insulation, the maximum instantaneous potential being greater with a peaked than with a flat top wave for the same value of the effective pressure. In testing insulators, the conditions should be duplicated as nearly as possible with respect to the electric and mechanical strains set up in insulators under the most severe conditions that would ever be met with in the transmission line:

The alternators generally used for long-distance transmission plants give very nearly a sine wave and therefore the testing generator should be one which will give a sine wave under all conditions. It is not sufficient to do so at full potential and no load, as tests are made with all degrees of excitation and with both leading and lagging currents.

The armature reaction should be as small as possible, which means that the generator should be much larger than would ordinarily be thought necessary. It is also desirable to have a high reluctance in the magnetic circuit to secure stability when running with weak fields and permit of control with a reasonable amount of field resistance.

There should be but one transformer used to step up to the highest potential required and its reactance should be as low as possible. A number of transformers in series is particularly bad, as it gives poor regulation and leads to great uncertainty as to the actual potential to which an insulator is being subjected.

Testing sets with transformers in series and a generator of poor regulation have been known to vary widely in the relation of the generator volts and the length of the spark gap due to change of wave form with different magnetic saturations of the apparatus and different numbers of insulators and consequently various capacities on the testing circuit. The only certain way to determine the real potential is to have a step-down instrument transformer on the high-potential circuit.

Assuming that insulators are to be passed upon for a specific transmission plant, they should first be inspected to see that they are free from cracks, bubbles or pits that will impair their strength or in which moisture can lodge. If of porcelain, the glaze should cover all the outer surfaces. The glaze is of no insulating value in itself, but dirt sticks to unglazed surfaces. Experience has shown that porcelain insulators which are not absolutely non-absorbent are worthless. The best porcelain shows a polished fracture like glass. If there is any doubt about the quality of the porcelain in this respect, it should be broken into small pieces, kept in a hot, dry place for some time, weighed and immersed in water for a day. When taken out of the water the weight should be the same as at first. A puncture test should be made by setting the insulator in a cup of salt water, filling the pin hole also with water and slowly increasing the potential between the top and bottom until the desired test potential is reached or the insulator either punctures or arcs over the surface.

If an insulator is built up of several parts, each part should be able to withstand a pressure greater than it will have to sustain when the complete insulator is tested. If it is to be tested for 100,000 volts and is made in two parts, each part might, for instance, be tested with 70,000 volts. The object of this is to have the weak parts rejected before they are assembled. A fair puncture test for an insulator is twice the potential for which it is to be employed, applied between the head and the interior for one minute. For example, the insulators for a 50,000-volt line should each stand 100,000 volts. As the potential from any wire to ground on a 5,000-volt, three-phase system would only be about 30,000 volts, a 100,000-volt test gives a factor of safety of nearly three and one-half to one. If one branch were grounded, as sometimes occurs in practice, the factor of safety would be but two to one. A one-minute test is not so severe as a continuous application of an equal potential, but insulators that have passed this test stand up well in service. New types of insulators should be mounted on iron pins and tested both wet and dry, to determine the potentials which will arc over them. The dry test is of little value, as the potential at which the arc jumps from the head to the pin can be pre-determined by measuring the shortest distance between them and referring to a curve of arcing distances in air. In a wet arcing test, a stream of water from a sprinkler nozzle under a pressure of at least 50 pounds to the inch should be played on the insulator at an angle of say 30° from the horizontal. This will be similar to the condition which exists in a rain and wind storm. The insulator should not arc over from the wire to the pin at less than the potential which will exist in service between any two conductors.

In no case should wooden pins be relied on for insulation, as their value is only temporary. All wooden pins in time become dirty and absorb moisture. Eventually they burn off unless the insulator is good enough to be used with an iron pin. If an insulator is going to fail, it is better to have it do so at the start and not interrupt the service by breaking down perhaps years afterwards.

In addition to the electrical tests, it is well (if the insulator is of a type that seems to require it), to try samples for mechanical strength. When mounted on pins the insulator should stand a side strain of at least ten times the pressure exerted by the air on the conductor with a wind velocity of say 100 miles an hour. It should also be able to slip the conductor through the tie wire should the former break.

The above tests are particularly desirable with built-up insulators in order to be certain that the parts will not separate. With such insulators, it would also be well to test them in tension along the axis of the pin. In transmission lines crossing depressions, such an upward pull is not infrequently exerted on the insulator.

A communication on Mr. Blackwell's paper from Mr. M. H. Gerry, Jr., said that several important matters in connection wtih the testing of high-voltage insulators were not touched upon. Insulators are tested for two purposes: First, to determine the design, shape, material and dimensions best suited for a given voltage and separate conditions; and second, as a matter of routine to determine if manufacturers have complied with specifications regarding material and workmanship. There can be no complete set of tests to cover the first purpose, as such tests are not only a matter of experiment, but also of skill and judgment in properly interpreting the results of the tests in relation to service conditions. The testing of insulators for the second purpose is comparatively simple. For glass insulators it is usually sufficient to inspect them for physical defects and incorrect dimensions and a certain percentage should also be tested for proper annealing and mechanical strength. A mechanical analysis of the glass of a few of the insulators is also desirable. Electrical tests of glass insulators are unnecessary as the physical inspection will reveal anything that should be found by an electrical test. Owing to many defects being covered by the glaze for very high voltages, porcelain insulators should be tested electrically and also carefully inspected during the process of manufacture before the glaze is applied. This is especially desirable for insulators built up of several parts and cemented together by glaze or other material, as defects in this type are difficult to detect even by electrical tests.

Referring to Mr. Blackwell's remark that the puncture test of insulators with twice the potential between wires is generally desirable where the insulators are to be exposed to severe lightning strains, Mr. Mershon said that he does not consider the latter an important point, since lightning will flash around but will not puncture an insulator. In tests of glass used in insulators he has never found that it differed in any way from ordinary glass. Mr. Lincoln took issue with the statement that glass insulators do not need testing beyond usual inspection. He cited an incident where insulators were inspected mechanically, but did not give a voltage test, where quite a number broke down in actual service, the defects of which would have been revealed by a voltage test. Mr. Lincoln agreed with Mr. Mershon that there is not much danger of insulators breaking down from lightning strains. In reply to an inquiry, Mr. Mershon said that between glass and porcelain, the only advantage the latter has over the former is that of mechanical strength, and sometimes it does not have even this advantage. However, in complex forms the porcelain insulator is cheaper than the glass one owing to the difficulties in constructing those of glass due to unequal cooling. As to the advantage claimed for porcelain over glass on account of less hygroscopic effect, he considered that in most power transmissions the leakage will dry up any moisture that should be deposited.

Mr. T. A. W. Shock agreed with Mr. Blackwell that in testing insulators the testing voltage should be at least three times that of the ordinary line voltage. Mr. Waterman criticized Mr. Blackwell's proposition to test separately the parts of the double insulator, as this would practically bar out this type. Moreover, in the baking or vitrifying of the two parts it is not desirable to take the entire shrinkage out on the first heat and consequently if the insulators are to be tested before being filled by glaze and vitrified, they are not tested at all in their final condition. Furthermore, there is more or less chance of getting sound porcelain in double insulators since the porcelain would be thinner. If the insulators stand up well under the mechanical test and show a glaze substantially free from large air spaces, they will usually stand up under the electrical test exceedingly well.

Mr. Thomas referred to the importance of annealing glass insulators and said that the breakage of such insulators during rain may more often be due to sun exposure on one side of a poorly annealed specimen than to electrical operation. He suggested that some tests should be gotten up to determine when glass is properly annealed. Mr. Chesney agreed with Mr. Thomas and referred to some experience in California in which very large insulators are used; after a very cool night they would drop off when the sun struck them on one side. Mr. Mershon said he did not entirely agree with Mr. Blackwell concerning the use of one transformer for testing purposes. A series of transformers need not affect bad regulation or seriously distort the wave form, and such a testing set has a very great advantage in that a transformer breakage is much less serious than in the case of the single testing transformer. He could not agree either that insulators should necessarily be tested on iron pins, since such a pin is likely to be the means of putting upon the insulators a mechanical strain out of all proportion to any which it will meet with in practice if installed upon a wooden pin. An insulator which will stand up well under a salt water test will often break down quickly when it is on a metal pin. Mr. Mershon considers that the wooden pin should not be condemned for any use where there is apt to be no trouble from burning; if the insulator is good enough to prevent burning, a wooden pin may be used unless there be some mechanical requirement which it cannot meet. He considered that any new type of insulator should be given a test while water is being sprayed thereon in imitation of rain. If a wooden pin is used in this test, it should be covered with tin foil from a point inside the body nearest the pin to a point two or three inches below, the voltage being applied between the foil and a wire around the neck of the insulator, representing the line wire. Mr. Mershon said that it had been his practice to adjust the spray for a precipitation of one inch in five minutes.

Mr. W. L. Waters, in a communication referred to the fact that the form of potential wave given by modern alternators differs very much from a sine wave, the worst case being that of the three-phase alternator having three slots per pole: in this case the wave form shows pronounced harmonics of five and seven times the fundamental frequency. However, few commercial machines having wave forms which would affect insulators are now seldom met with. An insulator will stand momentarily a voltage strain that if continued long enough will break it down, and this time effect is most marked in solid insulators, not applying to air. Porcelain insulators will stand a much higher potential if applied instantaneously than they will if applied continuously, and are practically unaffected by wave form.

The "Transposition and Relative Location of Power and Telephone Wires" was the title of a paper by Mr. Paul M. Lincoln. In opening the subject, to illustrate the extraordinary sensitiveness of the telephone receiver, Mr. Lincoln quoted an authority to the effect that the energy in a 16-cp incandescent lamp is sufficient to produce an audible sound in thirty billion receivers. Three ways in which telephone circuits may be disturbed by high-tension circuits are by electromagnetic induction, electrostatic induction and leakage. The electromagnetic effect may be entirely neutralized by transposing the telephone wires rgardless of whether the transmission wires are transposed or not, and a system of transposition which is designed to correct electromagnetic induction will also correct electrostatic induction.

Although a proper system of transposition will prevent the establishment of an induced e.m.f. between circuits, it does not necessarily prevent the telephone wires from assuming a potential which differs from that of the earth. A grounded power line may cause a potential between the telephone wires and ground which will reach well into thousands of volts, and even a bad power line insulator may cause an e.m.f. measured by hundreds of volts. This voltage strain comes not between the telephone wires, but between them and the ground. When it is realized that the potential between the telephone lines and ground may be as high as 30 per cent. of the potential between power wires, the importance of insulation will be appreciated. The insulation, however, should extend throughout the entire line, as there is little use in providing high insulation of poles and then inside buildings attach the telephone wires direct to woodwork which may be damp or to an instrument mounted on a damp wall, or include in the circuit a lightning arrester breaking down at 300 volts, as the standard telephone lightning arrester is expected to do.

So far as the telephone line is concerned, transposition of the power wires is not so important. An untransposed power line cannot induce either electrostatic or electromagnetic effects between two transposed telephone wires, but only between these two wires and ground. If the telephone line is insulated to meet the worst conditions, it will be ample to meet the normal conditions of an untransposed power line.

The series telephone is particularly objectionable for use on a circuit in which static induction takes place to any great extent, and bridge circuits only should be used where the lines are run in the vicinity of power lines. The capacity of telephone wires to earth should be made as great as possible and that of power wires to earth as small as possible. To decrease the possible potential of telephone wires to more than normal, one must either decrease the capacity of the power wire, telephone wire condenser

or increase the capacity of the earth wire, earth condenser, or both. This may be accomplished by increasing the distance between power and telephone wires and decreasing the distance between telephone wires and earth. One or more ground wires may be run in close proximity to the telephone wires, thereby increasing the capacity of the telephone wire-earth condenser to almost any desired limit. By this means the possible potential between telephone wires and earth may be brought within limits where it may be taken care of with safety.

In the discussion of Mr. Lincoln's paper a communication was read by Mr. M. H. Gerry, Jr., who said that there is no especial difficulty in installing a telephone circuit which will give satisfactory service and reasonable safety on a pole line carrying from 50,000 to 60,000 volts. In addition to the requisites mentioned by Mr. Lincoln, there might be added the use of certain safety devices to reduce the danger in handling the telephones. Mr. Gerry considers, however, that in addition to transposing the telephone wires, it is desirable also to transpose the main power circuits in order to reduce to a minimum the voltage to ground on the telephone circuits; but a few transpositions of the power circuits are required and the service is materially improved thereby. Where there is considerable lightning, the telephone circuits should be protected by lightning arresters of a design similar to those used on lighting circuits. The Missouri River Power Company regularly maintains a very satisfactory telephone service on its 50,000-volt transmission lines over a distance of 64 miles. Mr. Lincoln said that a telephone line ought to be so installed that it will at all times operate even if one leg of the power line is dead grounded. If it will operate under these conditions, it will operate under the normal conditions of an untransposed power line, since the normal static potential induced in the telephone line by an untransposed power line is vastly less than that which will be induced by grounding the power line.

Mr. Mershon said that assuming the electromagnetic and electrostatic effects as of constant potential, telephones should be wound for as high a resistance as possible. He did not agree in the objection against the use of series telephones, for they will operate properly if connected at even transpositions, and shunt instruments should be connected in the same manner. Instead of running a grounded wire in proximity to telephone lines, auto-transformers may be connected across the telephone lines at a number of points, preferably at each of the telephone stations, each having its middle point connected to ground. Such a device would protect the users of telephones from disagreeable and dangerous shocks, whether due to crosses, leakage or electrostatic induction, and would also help to minimize disturbances due to ground.

Mr. P. H. Thomas considered that the trouble on telephone circuits is chiefly due to electrostatic induction; there will also be a momentary disturbance if there is a discharge from a lightning arrester or any static discharge in the neighborhood. He suggested that it is possible to insulate the telephone wires to 30,000 or 40,000 volts in an extreme case, and at the end of the line connect to the primary of a transformer, the telephone being on the secondary, a very high insulation between the primary and secondary being provided. The same result may be possibly be accomplished with condensers. Another suggestion was to use for each set of telephone wires a twisted pair, one wire of the pair for the telephone circuit and the other of the pair grounded; this method would make a large capacity between the telephone wire and ground, but would not actually ground the telephone wire itself. Mr. Thomas also suggested the use of transmission wires themselves for sending signals by connecting a high resistance between each wire and a common point, the latter being connected to ground and similarly at the other end; a high-frequency generator being placed between the ground and the common connection at one end of the line, and the same kind of receiving apparatus at the other. The high frequency would prevent the transformers from taking too much current. He said that at the plant of Mr. Gerry he saw sparks from ground to telephone line something like half an inch long, indicating perhaps 20,000 volts. He dwelt upon the importance of protecting the man using the telephones, and Mr. C. E. Skinner also emphasized this point. Proper arrangements should be made so that the man need not touch anything which would connect him with the ground.

Mr. C. O. Mailloux said that he had observed that a transmission line may become spontaneously discharged electrostatically without being connected to any operating machinery. He noticed this about a year ago in Arizona on a 25-mile line, repeatedly observing that the three wires would become charged to a considerable tension under various conditions; if discharged by making connection with earth, they would become charged again. On one occasion the potential was so high that sparks of half an inch length could be drawn, and in no case were there any indications of lightning or storm. Another phenomenon which he noticed also at Phoenix, Ariz., is that a lightning arrester located at each end of the line had generally a tendency to a frying discharge, which is more pronounced between the lightning arrester gap of one line than the other.

Mr. Lincoln reiterated that the series telephone does not give good satisfaction when the circuit is run in proximity to power lines, as he has learned by experience. An objection which he brought against the use of auto-transformers, regular transformers, condensers or possibly resistances employed to reduce the potential between telephone wires and ground is that it takes the charging current off at points, whereas the current induced in the telephone wires is distributed along the whole length; and if taken off at points there will be a flow of current which would probably cause a disturbance in the telephone. Mr. Mershon said concerning the use of condensers on telephone lines that it seems desirable to keep the capacity of the lines as low as possible to get good operation from the telephone. As to signalling with the power lines themselves, it would be better to signal to neutral ground and receive messages at corresponding places at the end of the line. He considered that the objection of Mr. Lincoln against the use of an auto-transformer for each telephone does not hold, as the current would flow in the same direction in both lines, and the e.m.f. induced in each of the telephone wires would neutralize the current as far as the telephone is concerned.

Mr. C. C. Chesney then presented a communication entitled, "Burning of Wood Pins on High-Tension Transmission Lines." He considered that the success secured in the operation of the great majority of transmission lines is due to the good insulation of the insulator, the insulation of the pin not entering; and that for 40,000 volts and higher, the insulators at present made do not have the same factor of safety as those for lower voltages offered by the same manufacturers. This difference is due more particularly to the general shape of the insulator and the dimensions of the insulating surfaces and petticoats. In localities subject to salt storms, heavy sea fogs, or where there are chemical factories, there has been more or less pin burning without regard to the type of insulator used or to the potential of the system. In one case, owing to deposit on insulators from a neighboring chemical factory, trouble was experienced from the burning of pins at 440 volts, though 10,000-volt insulators were used. The paper includes engravings of insulators and pins to illustrate the discussion on the causes of the burning out of the latter. The conclusion of the paper is that the evidence presented, while not conclusive, points to the advisability of using iron pins with modern insulators properly chosen for the line potential.

In the discussion of Mr. Chesney's paper a communication was read from Mr. M. H. Gerry, Jr., who stated that in his experience, where burning of insulator pins has occurred it has been due to leakage of current from the surface of insulators coupled with resistance conditions in the pin such that sufficient heat is developed to char the wood. A thoroughly dry wooden pin 15 in. long will stand indefinitely 100,000 volts, while a green pin the same length will break down very quickly under 1,000 volts. Paraffining the pins on the outside or coating them with asphaltum paint or linseed oil is of no value. If the pins when thoroughly dry are dipped into an insulatig material, they may be given a high insulation. In order to prevent burning of pins, they should have either very high or very low resistances. Mr. Gerry said there is nothing especially mysterious in the burning of pins on high-tension lines, as it is merely a matter of total resistance to ground and the relative resistance of insulators, pins, cross arms and poles. Wherever burning occurs, it can be remedied by altering the design of the material or dimensions of the insulators and changing the quality of the pins.

Mr. H. W. Buck said he had found many pins on the Niagara transmission in which disintegration had occurred at the top of the pin; this would crumble into white powder which, when analyzed, was found to be a nitrate salt. This would appear to indicate that nitric acid was formed by the static discharge of the pin and had attacked the wood. He gave an account of an experimental 75,000-volt, single-phase line, the conductors of which were of iron tied with copper wires. At the end of five months the galvanized iron had turned black, although the iron guy wires remained in their

original bright condition, thus indicating that the blacking was not due to atmospheric conditions. It was noted that the wire became discolored on the surface to the depth of several thousandths of an inch, and the copper tie wire was also attacked to a certain depth, but not as much as the iron; this would appear to indicate that a nitrogen compound formed in a thin layer around the conductor at high voltage, due to brush discharges, and uniting with moisture, attacked the metal.

Mr. Lincoln considered that pins should be treated with a view to preserving them and not making insulators of them. Mr. Mershon pointed out that when pins burn, the insulator, the lower part of the pin and the cross arm have their surface resistance lowered by moisture or otherwise; but the upper part of the pin, being protected by the insulator, does not have its surface resistance so much decreased, the consequence being the burning of the unprotected surface. In some cases the inner surface of the insulator next to the pin, and the pin itself, are so well protected by the insulator that the current instead of leaking over the surface of the insulator to the pin, jumps in a brush discharge from the edge of the petticoat to the lower part of the pin. Mr. Mershon mentioned three possible remedies for trouble due to charring pins, as follows: First, making the design and pins of the insulator such that for all conditions the surface resistance will be so high as to control the leakage and keep it below a point which cannot harm the pin. Second, make the pins fire-proof, but non-conducting. Third, make the pins conducting.

The latter remedy involves the use of iron pins. Mr. Mershon thinks, however, that there is a chance of trouble from the use of iron pins due to the unyielding character of both the iron and the porcelain or glass, and their widely different coefficients of expansion. The use of a wooden thread upon iron pins may still permit charring. If a wooden cross arm is used with an iron pin, the seat of the charring trouble may be transferred to the cross arm, unless the pins be connected by a conductor. It would seem better to make the design of the insulator such as to protect the pin.

Mr. De Muralt said that in Europe practically all high-potential installations use iron pins, and quite frequently the poles are constructed entirely of iron, the only insulation relied upon being that of the pole insulator. He does not think that much difficulty will be found from mechanical strains; and if there is, a way to avoid such strains is to fix the pin into the insulator by means of a cement that will take up such strains. In a great many installations with which he is familiar, such a cement is made of a mixture of litharge and glycerine. He considers that the best plan is to put the entire insulation into the insulator, and then let the rest of the pole take care of itself. He referred to two installations operating at 26,000 volts, which use American glass insulators on iron pins and iron poles; and another one of 25,000 volts using porcelain insulators. None of these installations has given any trouble whatever.

Mr. W. N. Smith said that the question of cost will usually govern. Iron poles, for example, in this country cost anywhere from $30 upward as against from $7 to $20 for wooden poles. The kind of pin also affects the cost of the cross arm, and where lumber is high an extra cost may run into a good many thousand dollars.

Mr. Chesney, referring to the remarks of Mr. Mershon in reference to the use of a wooden thread on an iron pin, said that in the particular case which he mentioned, the burning was not serious, simply consisting of a puncture in the thread at one point. He said that litharge and glycerine had been used to some extent for iron pins in this country, but lately Portland cement has been substituted. One of the largest new transmission lines now being erected in Mexico uses Portland cement and iron pins and instead of iron poles, iron towers will be used having a distance between the insulators of from 420 to 500 ft.

Prof. W. S. Franklin exhibited a model by means of which the distribution of e.m.f. or current along a single-phase, alternating-current transmission line can be illustrated. It rests upon the principle that a helical line drawn on a transparent cylinder rotating about its axis appears to an observer looking at it from one side as a wave line traveling along the axis. A rotating right-handed helix would represent the e.m.f. or current waves and a left-handed helix rotating in the same direction along the axis would represent the e.m.f. or current waves reflected back from the receiver, the condition applying to a line having neither resistance nor leakage. By choosing a helix-like line satisfying an equation given in the paper, the model may be made to illustrate a transmission line having inductance, capacity, resistance and leakage.

An Inventor, a Wheel and an Airship to Run to Mars.

By F. A. Shepard.

The writer is a poor inventor who has worked years on a wheel and only recent discoveries in the scientific inventions of to-day has enabled him to get power out of it to run a special kind of motor. It is no humbug, you can rest assured, but I cannot give away the secret of the detail parts without some other inventor gobbles it up and claims it with some little improvement as *his own idea.* It is a magnetic wheel that will run of itself and also by wind, at the same time. This wheel would run for years or until it clogged up with oil. It would have power enough to run two fan wheels to propell a 20-ft. airship at the rate of about 100 miles an hour, perhaps more, but not against the wind. The airship would be the shape of a sun fish almost and feather to the wind and point upward. It would be built in six sections of aluminum, glass and mica. The wheel has a hollow rim and spokes, has drop magnets inside, and a wrought-iron ball; also a small quantity of radium. The dropping and raising of the magnets cause the wheel to revolve (we do not propose to give the secret details). The spokes of the wheel are feathered with a wind fan that will cause the wheel to revolve also, but we do not depend on that, but on the magnets and the ball and the radium. Once set the wheel has got to revolve and in turn gives off electromagnetic power to two small motors that run the fan wheels.

This wheel was first invented in 1876, but had no power until two new inventions recently discovered came out. Now the power is at hand; radium is one that makes it work and keeps it working over and over again. Once on the move the wheel cannot stop of itself. This wheel would send a 20-ft. airship to another planet. It can be done now.

Iowa Telephone Association.

The seventh annual meeting of the Iowa Telephone Association was held in the Ordinary of the Savery House, Des Moines, March 10 and 11. The report of the committee on credentials showed that about seventy companies had paid dues and were entitled to vote. The Treasurer's report showed a comfortable balance in the bank. The annual address of President U. S. Alderman called attention to the Association's work in the past and in a measure outlined its future course and the need of co-operation among the independent telephone men of the state.

The programme executed and list of papers follows: "Cedar Poles," B. J. Carney, Grinnell; "A New Set of Arbitration Rules," U. S. Alderman, Nevada; "The Recent Supreme Court Decision," J. C. Hume, Des Moines; "A Uniform System of Toll Accounts," Miss Flora B. Herr, Ottumwa. "The Rules for Arbitration" were referred to a committee and were reported back and adopted by the association without change. They are very complete and will doubtless aid in settling many controversies.

Mr. Hume's address was of special interest as many companies are affected by the decision of the Supreme Court, which is that companies doing business prior to October, 1897, have the right to occupy the streets and alleys of incorporated towns without franchise from the municipality. Mr. Hume represented the apellee in the case and was therefore thoroughly qualified to handle the subject.

Following Miss Herr's paper the Association decided to attempt to unify the toll account system by bringing together toll operators from various exchanges and giving them uniform instructions.

The following officers were elected: President, H. S. Herr, Ottumwa; vice-president, J. C. Sullivan, Creston; secretary-treasurer, Charles C. Deering, Des Moines. Executive Committee—H. S. Herr, Ottumwa, H. C. Raney, Fairfield, Geo. N. Bandy, Des Moines, U. S. Alderman, Nevada J. S. Bellamy, Knoxville. The following arbitration committee was appointed: J. S. Bellamy, Knoxville, A. T. Presson, Iowa City, U. S. Alderman, Nevada. The meetings were well attended; the manufacturers and supply men made good exhibits and the convention was a success.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

ELECTRIC FURNACE.

Mr. Charles S. Bradley, of New York, patents a modified form of the rotary type of continuous electric furnace, the improvement consisting in providing the several sections which constitute the rotating drum or annulus with lining plates of carbon or graphite, the idea being that these refractory faces will permit the fusing operation to be extended throughout the entire body of the charge without injury to the furnace structure, instead of being confined to the central portion as heretofore. It has been customary to leave portions of the charge adjacent to the walls as a protection against the intense heat of the converted mass, and it is argued that this involves waste not only of the raw material, but, through the necessity for freeing the product from the unconverted or partially converted charge of the finished product. However, a carbon or graphite-lined furnace is not new in the art. The present construction is presumably intended for the manufacture of calcium carbide.

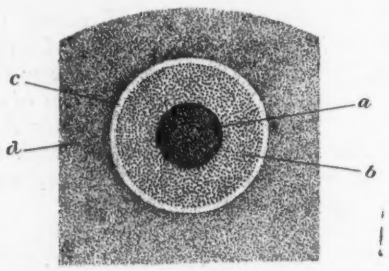
PRODUCTION OF ELECTROLYTIC CAUSTIC.

Mr. Ernest A. Le Sueur, of Sault Ste. Marie, Canada, patents an electrolytic method involving the use of a caustic cell comprising anode and cathode compartments separated by a diaphragm of asbestos. The diaphragm is vertical and the cathode of wire net is in contact with it and supported by a frame of slate. The anode compartment is filled with the solution—brine—to be decomposed and the cathode compartment with water in which the caustic dissolves as formed, the level of the liquid being maintained somewhat higher in the anode compartment in order to secure a regulated flow through the diaphragm and cathode.

The invention is directed to the reduction of diffusion from the cathode to the anode side through the diaphragm, and consists in adding continuously to the liquid in the cathode compartment cold water, thereby displacing an equal volume of the alkaline solution. The effect is two-fold, first a dilution of the alkali in the negative compartment, whereby an equal volume diffused through the diaphragm carries less caustic, and second a reduction of the temperature whereby the diffusion itself becomes less rapid. It follows, of course, from the first effect that the caustic lye obtained as the product of the cell is less concentrated than would otherwise be the case.

METHOD OF HEATING MATERIAL.

Mr. Acheson patents a method, the purpose and effect of which is expressed as follows in one of the claims: "The method of conducting reactions which proceed under definite temperature conditions, which consists in maintaining within a mass of material regions



METHOD OF HEATING MATERIAL.

of definite maximum and of minimum temperature, both of which are comprised within the temperature limits of the reacton, whereby the operation is conducted throughout the entire mass of the material under treatment." The specific example given is an interesting one, being the production of the amorphous compound technically known as "white-stuff"—a body consisting largely of silicon and carbon, and formed incidentally and in relatively small quantity in the carborundum furnaces.

As shown in the accompanying drawing indicating the relation of the several materials remaining in the furnace at the close of the ordinary carborundum operation, *a* is the carbon core, *b* the surrounding mass of carborundum and *d* the unconverted charge. The narrow strip indicated by *c* is the "white-stuff," and the fact that the region in which it is found is so limited indicates that the difference between the temperature at which it forms and that at which it decomposes is, relatively speaking, but slight. Mr. Acheson's immediate problem was to construct a furnace in such manner that these upper and lower temperature limits should not be transgressed, so that the entire body of the charge might be converted into "white-stuff."

The furnace now described by Mr. Acheson utilizes a series of equally spaced carbon cores distributed throughout the body of the charge, the distances between the cores being so related to the heat developed within them and to the heat-conductivity of the charge, that while the regions of maximum temperature around the cores do not exceed the upper limit of the reaction, the intermediate minima do not fall below the degree of temperature requisite for the production of the compound. By this arrangement, as will readily be understood, the formation of the compound occurs throughout the body of the charge.

Electric furnaces have, of course, hitherto been constructed with a plurality of resistance rods, but this is quite distinct from the present invention. The conception of a relation such as is now disclosed is a novel one.

New Telephone Patents.

The majority of the patents bearing the date of March 24 relate to receiver holders. No less than four of these appear, ranging from the simplest semi-flexible support to fairly complicated affairs having automatic switching and other functions to perform. Some time since comment was made upon the relatively great number of patents which are appearing covering these devices for relieving one of the labor of holding the receiver during conversation. At that time the encouragement to leave the receiver "off the hook," which such devices give to the subscriber, was noted. In no less than three of the present devices this defect is largely overcome.

Two of the new receiver holders invented respectively by F. J. Becker and D. W. Shiek are based upon the same principles, differing only in the manner in which the apparatus is constructed. Both use a base adapted to be secured to the wall near a telephone wall set, which base carries a receiver-supporting arm, extending in a substantially horizontal direction and pivoted about a vertical axis. A spiral spring surrounding the pintle of the hinge normally maintains the mouth of the receiver nearer the center line of the transmitter than convenient for use. Thus, when one places his mouth in position before the transmitter for speaking, his ear will engage the receiver and force it away from the normal position against the spring. This action serves, by means of linkages, to operate the telephone switch-hook just as though the receiver had been removed from it at that instant. Again, just as soon as the pressure upon the receiver is removed the supporting arm returns and depresses the hook. For the purpose of enabling one to hold the line, both inventors provide gravity locks, which, when set by hand, will retain the receiver arm in an intermediate operative position. When, however, the pressure is again applied to the receiver, the lock automatically releases.

J. P. Riedinger is the inventor of a third of the new holding arms. This is only applicable to magneto instruments wherein it is necessary to call and clear out by magneto generator. Mr. Riedinger dispenses with the usual magneto crank, arranging his receiver-supporting arm so that it will operate the magneto when being moved either to or from the listening position. The pivoted receiver arm swings in a vertical plane, carrying with it a sector gear. Engaging with this gear are two trains, one direct and one reverse, connected to the magneto shaft by right and left-hand ratchets respectively. The receiver arm also carries the contact springs which control the talking circuits. The device is unnecessarily complicated by the supposition that a magneto must be operated solely in one direction. There seems to be no necessity of imposing such a condition, especially when attended by considerable expense.

The fourth receiver-holding arm is of the simplest sort, comprising a base and two adjustable arms. The main arm moves about an axis substantially parallel to that of the transmitter arm hinge, while the second arm moves in a plane parallel to the wall. The patent for this arm is granted to Sigmund Konigstein, of San Francisco.

A reissued patent covering the special receiver circuits devised by Charles G. Burke, of Brooklyn, is also included in the patent issue of March 24. These circuits were noted at some length in these columns a few weeks ago.

The Construction of Aerial Telephone Lines—VIII.

BY ARTHUR V. ABBOTT, C. E.

DISTRIBUTION.

THE pole line has always been a favorite with the telephonist from the ease with which it enabled him to reach sub-stations. The customary method of distribution has been to drop off a pair of wires at each station. This has been usually accomplished by dead-ending the pair and attaching each side of the drop wire to a corresponding side of the line by a McIntire joint at the insulator, or by clamping the drop wire to the line wire by means of a brass or copper clamp, such as is shown in Fig. 14. Neither of these methods has proved satisfactory, although both are still commonly applied. The drop wires are usually more loosely strung than the line wires, and are, consequently, greatly affected by the wind and are constantly swaying. This tends to twist off the McIntire, or else to turn the clamp upon the line wire. Both of these actions operate to rupture either the line wire or the joint between

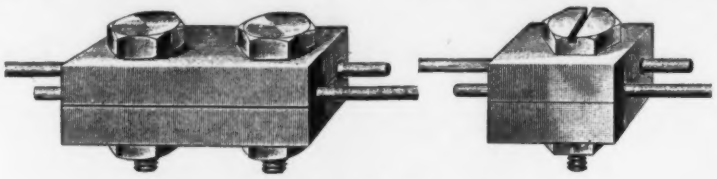
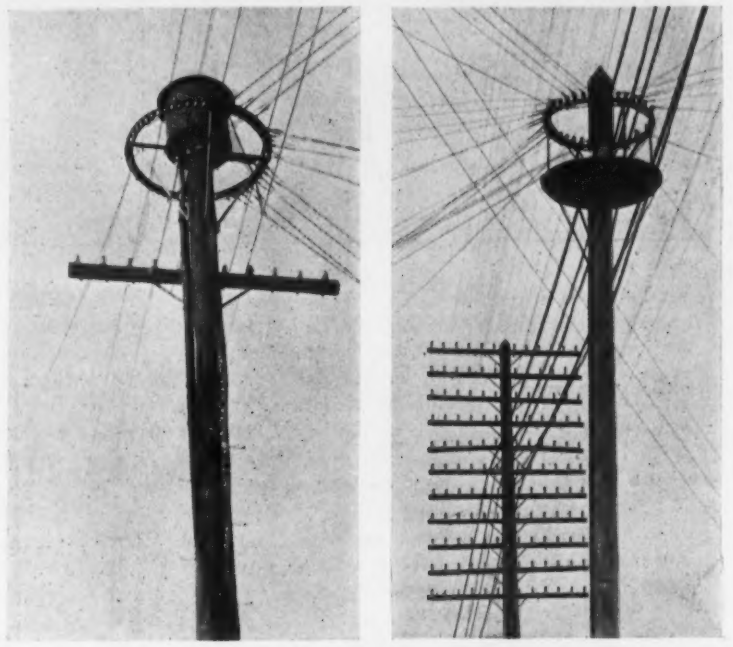


FIG. 14.—CLAMPS.

the line and the drop; consequently, broken house connections are a constant "bug-bear" to the wire chief.

The increasing employment of aerial cable upon pole lines is rapidly multiplying the distributing pole, and there seems to be no reason why the distributing pole should not be used as a method of distributing open wire as well as aerial cable. As its name indicates, the line wires converge to the distributing pole, and from it the drop wires run to the subscribers. Present practice tends to a distributing pole, provided with a circular ring, some five or six feet in diameter, that is placed upon the top of the pole. This ring is supplied with a number of insulators, to which the line wires run and are there dead-ended. Drop wires are made usually of a twisted pair of double-braided okonite or similar material. Each drop is attached to its pair of insulators and then swung in a single span to the premises of the subscribers which it is intended to serve. Samples of the tops of distributing poles are shown in Figs. 15, 16,



FIGS. 16 AND 17.—DISTRIBUTING POLE TOPS.

17, 18 and 19, while Fig. 20 shows the pole in process of construction; that is to say, the pole is erected, the ring in place, and the linemen are engaged in attaching the line and drop wires. Figs. 16, 17, 18 and 19 are examples of good construction—15, 17, 18 and 19 being particularly commendable, while Fig. 21 is an illustration of what not to do. The pole, as will be seen, is top-heavy, and badly proportioned, having a top of greater diameter than that of the pole some feet beneath it, and, in general, is in an exceedingly disorderly and untidy condition. Formerly it was customary to construct the pole ring, carrying the insulators, of seasoned hard wood, supported upon iron braces, but recently designs, which are much more mechanical and substantial, have appeared. Thus Fig. 22 shows a pole top which is constructed by bending a light channel into a ring, to

FIG. 15.—DISTRIBUTING POLE TOP.

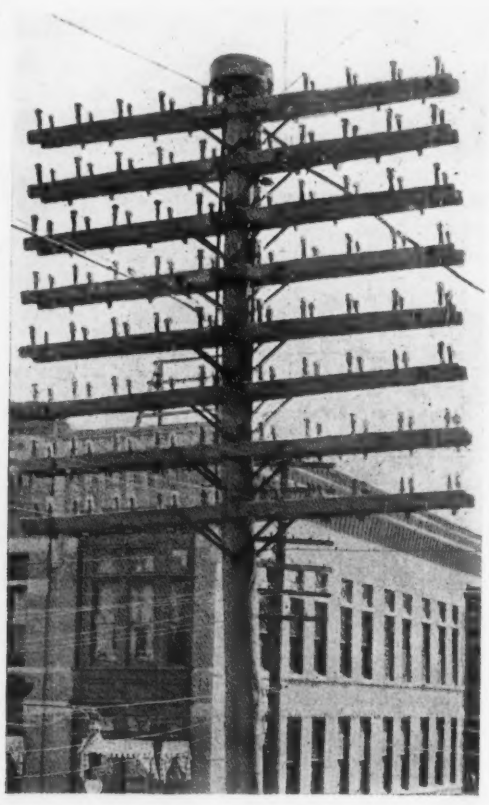


FIG. 19.—DISTRIBUTING POLE TOP.

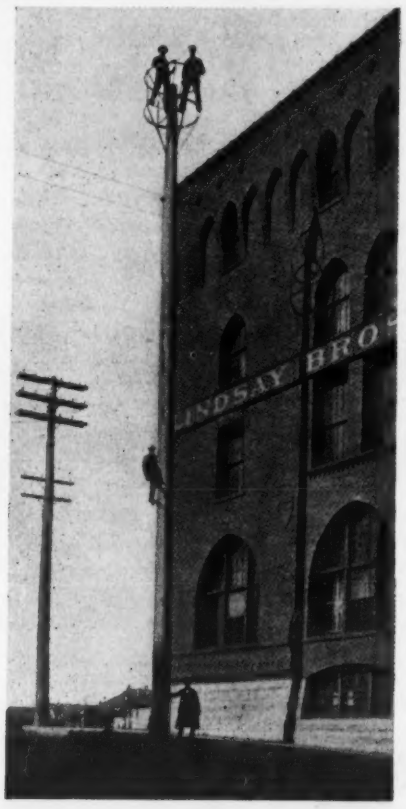


FIG. 20.—CONSTRUCTING A POLE TOP.

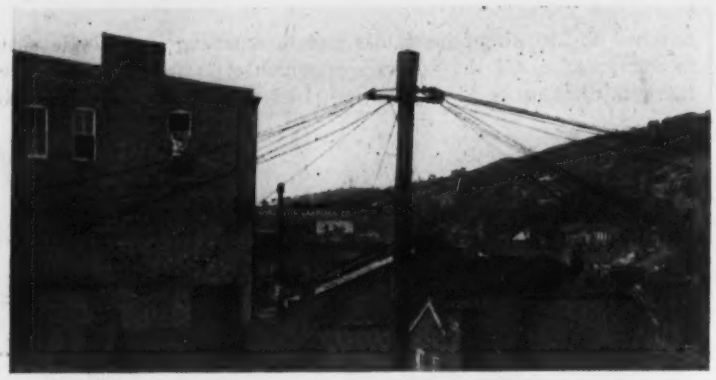


FIG. 18.—DISTRIBUTING POLE TOP.

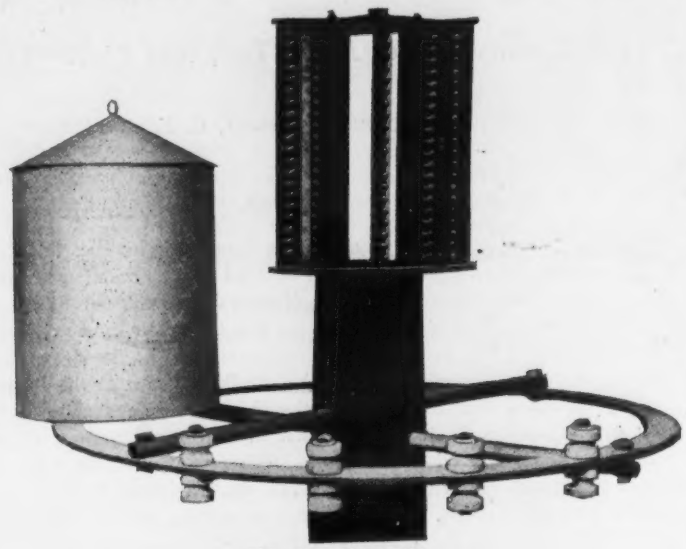


FIG. 23.—POLE TOP.

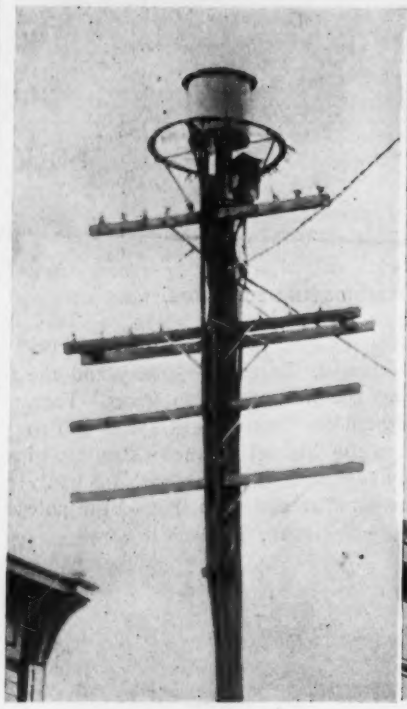


FIG. 21.—POLE TOP OF BAD DESIGN.

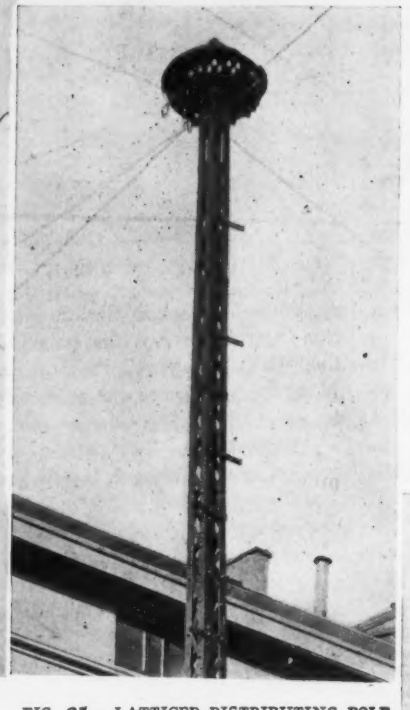


FIG. 25.—LATTICED DISTRIBUTING POLE.

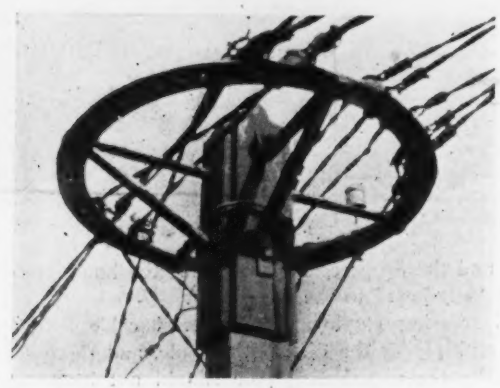


FIG. 25.—POLE TOP.

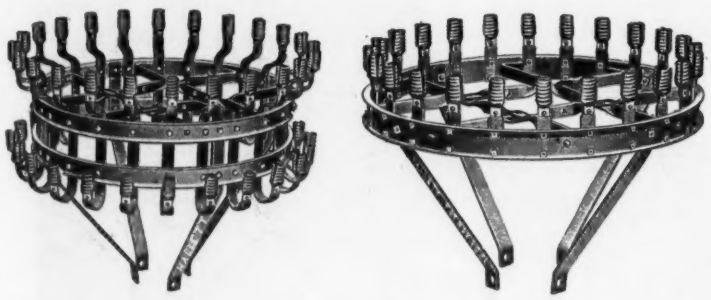


FIG. 22.—DETAILS OF POLE TOP.

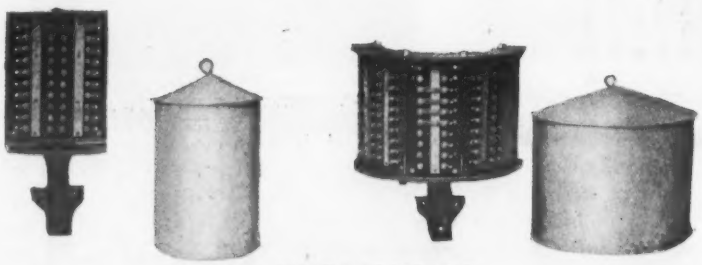


FIG. 23A.—DETAILS OF POLE TOP.

FIG. 26.—ORNAMENTAL DISTRIBUTING POLE.

VARIOUS DESIGNS OF TELEPHONE DISTRIBUTING POLES.

which the insulators are attached by bolting to the ring a bracket pin, upon which the insulator is placed. The whole top is then secured to the pole by bolting both by diametrical braces in the inside of the ring, and by the vertical braces extending from the circumference to the pole. A still more elaborate design is shown in Figs. 23 and 24. The pole is provided with a kind of cable terminal, the ten and twenty-five-pair size being shown in Fig. 24, and fifty-pair size complete erected upon the pole, in Fig. 23. The ring is composed of a circular flat iron secured to the pole by two transverse pipe braces. Upon the circumference of the ring insulators are bolted, one of each pair being respectively on the top and the bottom of the ring. Upon the top of the pole the cable box is placed which consists of vertical strips, as shown in the illustrations, which are mounted between two parallel rings. The strips are made of hard rubber, and carry cable terminals to which the protecting fuses are attached, and from which the bridle wires run downwards to the distributing ring. A metal cover surmounts the whole of the terminal, and protects it from the weather. A near view of the top of a distributing pole of this kind is shown in Fig. 15, while Fig. 24 shows the top of a ring-distributing pole, carrying wires from an open wire line. Owing to their importance, it is necessary to be more careful in the construction of distributing poles than those in the ordinary line, and the writer is glad to note that the use of iron poles is beginning to make some headway. Figs. 25 and 26 show two poles of this nature. Fig. 25 is a light distributing pole of four angles, latticed together and used by the New York and New Jersey Telephone Company in Brooklyn. Fig. 26 is a much more pretentious, elaborate and handsome pole, and is erected by the Twin City Telephone Company in Minneapolis. To a structure of this description no exception can be taken, and the Twin City Company is certainly a pioneer in the excellent character of the pole line work which it is doing.

A. I. E. E. Boston Branch.

At a meeting of the Boston branch of the American Institute of Electrical Engineers March 26, the organization of the branch was completed by the election of officers, as follows: Chairman, C. L. Edgar; secretary, Ralph W. Eaton. Executive Committee—C. L. Edgar, R. W. Eaton, Dr. Louis Duncan, Dr. A. E. Kennelly and C. B. Burleigh. At the meeting a paper was presented by Mr. James F. McElroy on a new system of train lighting. The papers of Messrs. Bliss and Farnsworth presented at the February meeting of the Institute were read in abstract by Messrs. Welsh and Porter, of the M. T. I. Electrical Engineering Society, and discussed by Messrs. Duncan, Lee, Fleming and McElroy. Refreshments were served after adjournment.

Electrical Instruction for Officers at Sandy Hook.

As an aid in the instruction of officers of the army in electricity and electrical apparatus, the government has recently ordered from the Westinghouse Electric & Manufacturing Company a 30-kw, alternating-current, composite-wound, belt-driven generator, delivering two-phase current at 220 volts, and 7,200 alternations, running at 1,200 r.p.m.; one 1½-kw, direct-current, direct-connected, compound-wound, multipolar exciter of 125 volts and 1,300 r.p.m., and a 1-hp, single-phase, alternating-current motor of 200 volts, 7,200 alternations and running at 1,600 r.p.m., together with starting rheostat and other auxiliary apparatus. There is also being supplied a 10-kw rotary converter, two and three-phase, 220 volts, alternating-current, 7,200 alternations and 1,800 r.p.m. This rotary converter is provided with an extended shaft for operation as an alternating-current and as a direct-current generator, together with two auto-transformers, which provide for the raising of the alternating-current voltage from 175 to 220 volts when the rotary converter is operated from the direct-current side; and a direct-current, 125-volt, compound-wound multipolar exciter of ¾-kw capacity. Added to the above are four 7½-kw transformers, 2,200 volts primary and 220 volts secondary, arranged to operate on two-phase or three-phase. These are to be installed at the Sandy Hook Proving Ground, with complete switchboard and detail parts, having recently been accepted by Captain Dunn, U. S. A.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN CHICAGO.—Experiments are being made with the use of the wireless telegraph between the down-town offices of the Armour Company, of Chicago, and their offices at the Union Stock Yards, about four miles distant.

GERMAN WIRELESS TELEGRAPHY.—A cable dispatch from Berlin of March 31 says: While Emperor William was riding through Under den Linden two or three days ago, says a weekly paper, he noticed Director Rathenau, of the Allgemeine Elektricitäts Gesellschaft, and, beckoning him to his side, the Emperor said it pleased him to see his company had obtained from the United States Government a contract to erect wireless telegraph stations in Alaska.

LITERATURE FOR RIVER PLATE.—The secretary of the Institution of Engineers of the River Plate, Buenos Ayres, Argentine Republic, writes us as follows: "The council would esteem it a favor if you would kindly publish a notice in your paper to the effect that we shall be pleased to receive catalogues for placing in our library from manufacturers, etc. These will all be properly classified and the result is certain to be beneficial to those who favor us with their catalogues. Thanking you in advance. The address is Calle 475, B. Mitre, Buenos Ayres.

MARCONI IN ENGLAND.—In London, on March 31, at the annual meeting of the Marconi Company, Mr. Marconi said he attributed the criticism of his system chiefly to the "cable companies and the sections of the English technical press controlled by the cable companies." He announced that Lord Kelvin, Lord Rayleigh and Prof. J. A. Fleming, professor of engineering, University College, London, were soon going to Poldhu, Cornwall, at his invitation to examine thoroughly his transatlantic wireless system of telegraphy. An extension of the plant, he added, was necessary before the company entered into commercial business of large scope. The capital of the company was then increased from $1,000,000 to $1,500,000.

DRESDEN EXPOSITION OF MUNICIPAL GOVERNMENT.—Consul-General Charles L. Cole writes from Dresden, February 13, 1903, that an exhibition will be held in that city from May 20 to September 30, 1903, which has for its object the study of improvements in municipal government and welfare. This will include street railways, street paving and cleaning, gas and electric lighting, cabs, automobiles and kindred subjects. Invitations are sent to the prominent cities in the United States of America to appoint delegates to this exposition. Further information may be obtained by interested parties by addressing Oberbürgermeister, Geh. Finanzrath a. D. D. Beutler, Dresden, Saxony. Circulars (in German) setting forth the scope of the exhibition are filed for reference in the Bureau of Foreign Commerce, Washington.

N. E. L. A.—Mr. Henry L. Doherty, chairman of the Committee on the Analysis of Flue Gases, will make a very complete report at the twenty-sixth convention of the National Electric Light Association, to be held at Chicago May 26, 27, 28, and will give practical demonstrations of a simple method of detecting and preventing the loss of a great deal of power that is often allowed to go to waste. This report will undoubtedly be of great interest to central station managers who are not satisfied with the results they are obtaining from fuel consumed. Among the new members recently added to the membership list are the following: Union Electric Company, Dubuque, Iowa; Mountain Electric Company, Denver, Colo.; De Kalb-Sycamore Electric Company, De Kalb, Ill., and New York & Queens Electric Light & Power Company, Long Island City, N. Y. The manufacturing and supply companies are also showing that they appreciate the usefulness of the association, and there are a number of new associate members, among them being the Crocker-Wheeler Company, Ampere, N. J.; Chase-Shawmut Company, Boston; Chas. F. Johnson, Buffalo, N. Y.; Gregory Electric Company, Chicago, Ill.; the Buckeye Electric Company, Cleveland, Ohio; Adams-Bagnall Company, Cleveland; Hemingray Glass Company, Covington, Ky.; Stanley Instrument Company, Great Barrington, Mass.; the Green Fuel Economizer Company, Marreawan, N. Y.; Alberger Condenser Company, New York City; Standard Vitrified Conduit Company, New York; Doubleday-Hill Electric Company. Several others have signified their intention of taking membership.

N. A. M.—The annual convention of the National Association of Manufacturers will be held at New Orleans on April 14, 15 and 16, when a number of interesting and important subjects will be up for discussion. Mr. Marshall Cushing, 170 Broadway, is secretary. Hotel reservations can be had from Mr. Edward Davis, St. Charles Hotel, New Orleans. A large attendance from the North and West is expected.

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.—Italian newspapers of recent date announce an invention by Signor Turchi, an engineer, and Prof. Brune, by which telegraphic and telephonic messages can be transmitted simultaneously over the same line. It is further stated that Signor Galimberti, Italian Minister of Posts and Telegraphs, is about to test the invention on the government lines, and that if its operation is satisfactory it will be adopted by the government.

ROLLER TROLLEY.—A patent granted March 17 to Charles A. Terry describes a trolley consisting of three contact rollers so supported that at least two of the rollers will always be in contact with the trolley wire when the device is in use. The three rollers are mounted on a triangular frame pivoted at its center of gravity to the trolley fork. There will thus always be two of the rollers in contact with the trolley wire, and as the roller frame is revolvable in the trolley fork, the bearing at different times will naturally be on different pairs of rollers.

THE MARCONI SYSTEM IN NAVIES.—Under a tentative engagement 32 British warships have, according to a recent despatch from London, been equipped with the Marconi system of wireless telegraphy. It is stated that the Admiralty has agreed to pay the Marconi Company a substantial sum of money which will entitle it to equip the entire navy. It is stated that the U. S. Cruiser "Topeka" is being fitted up with the Marconi system. This ship is said to be the first one of the U. S. Navy to be equipped with wireless telegraph apparatus.

SIGNAL CORPS AND GOLD.—A special dispatch from Washington, D. C., says: General Greely, chief signal officer, has found himself much embarrassed in the construction of telegraph lines in Alaska by the reported recent discoveries of gold deposits in the Tananah section of the country. Almost to a man the civilian employees of the Signal Corps have deserted their work and started for the new diggings. The gold fever also infected the enlisted men of the corps, and undoubtedly there would have been many desertions could the men have made sure of getting out of the country without being arrested. As it is, applications for discharge are coming in from them in regular form, but not many of them can now be granted.

ELECTRICITY FOR SWEDISH ROADS.—Mr. Arvid Westerberg, who furnished a very interesting article to our issue of March 21 on the proposed adoption of electricity for railways in Sweden, writes us pointing out that the plan is intended not for all the railways of the country, but specifically for the government network. He adds: "The map used, in this connection and with its present title, gives the impression that the railroad system of Sweden is rather insignificant, while in fact the mileage per inhabitant in Sweden is higher than in any other European country. On the other hand, there is no doubt that the private railroads will follow the example given by the government roads, which of course will improve considerably the economy of the whole system."

LOCATING METALS.—A cable dispatch from London of March 27 says: "The *Times* publishes an account of a demonstration of the Daft and Williams system of locating mineral ore which was given at the Telacre lead mine in North Wales. An alternating current of high potential is used to energive the ground thought to contain mineral deposits. The current is taken from terminals to two metal rods pushed an inch or two into the earth. These act as distributors of the electric force, which is detected by means of a delicate telephonic receiver attached to another pair of rods stuck in the earth in any required position. The presence of ore is indicated by the greater or less intensity of the sound produced in the telephone." The Daft referred to is Mr. Leo Daft, so well known in this country on account of his pioneer work on electric motors and electric railways 20 years ago.

SELECTIVE WIRELESS TELEGRAPHY IN GERMANY.—A cable dispatch from Berlin of March 21 says: "Experiments have been made before representatives of the Admiralty Secretary and the commander of the torpedo division with a new system of wireless telegraphy, which directs electric waves exclusively to one point, obviating the danger of outsiders catching messages. The result is obtained through a series of parabolic mirrors, which give all the electric waves a parallel course. The system is available for distances of twelve to fifteen miles and is intended principally for communication between vessels in harbor or along the coasts. The transmitting velocity is twenty-five words per minute and the inventor is Ernst Ruhmer, a report of whose experiments with a wireless telephone system was cabled to America last fall." Mr. Ruhmer's work has already been noted in these pages last December.

MARCONI SERVICE IN ENGLAND.—With regard to the handling of Marconi messages by the British Postal Telegraph system, the *London Daily News* says: "The government consents to the two systems being linked, but it does not consent to messages being exchanged. So far as immediate advantage is concerned, therefore, neither the Marconi Company nor the public has cause for exuberant rejoicings. True, the concession involves one immediate boon, which, though of modest dimensions, is not to be disregarded. It will be possible for the public to visit the London office of the Marconi Company, and there hand in messages intended for ships at sea or for Canada. For, as the reader will scarcely need to be told, the decision of the Post Office not to consent at present to intercommunication between the system of visible wires and the system of invisible waves reposes on a purely negative basis. No prohibition will be necessary. Nay, there will be nothing to prevent the public sending to Poldhu from any part of the country messages intended for Hertzian transmission from Cornwall. All that will happen is that the clerk in the telegraph office will decline to accept payment for wireless transatlantic transmission."

A CONEY ISLAND THRILLER.—The "circle swing" is a new "fool-killer" and thriller at Coney Island this year. There is a central tower 100 ft. high, from the top of which radiate six arms, the distance apart being 48 ft. at the outer ends. To the ends of these arms are attached wire cables, and to these in turn are attached the cars, each car being constructed to seat six persons. The arms are revolved by electricity, and the power is increased with each revolution. It is estimated that five and a half revolutions will swing the cables, with cars attached, out to such a distance that the space between the cars instead of being 48 ft. will be 200 ft. When the cars are swinging around the tower at the extreme distance they will be traveling 700 ft. each time they revolve and at the rate of 22 miles an hour. It is calculated to give the passengers about twelve turns, which will occupy about three minutes, and to charge them ten cents a ride. It is asserted that there is no danger in this two-mile ride through the air, a gradual reduction of speed allowing the cables to narrow their circles until they assume their original vertical position. If there be not sufficient passengers to properly balance the cars weights will be used. This ought to draw the crowd.

CABLE CODES are said to be occupying the attention of exporters and others. A new official "vocabulary" has been prepared by the Bureau of International Telegraphs at Berne, Switzerland, to which the International Telegraph Convention, at the coming conference in London next May will give consideration, with a view to adopting it permanently. Some opposition to the new vocabulary has developed, principally on the ground that it may not contain many of the words in the several cable codes now used, and that, owing to the growing complexity of modern business methods, a compulsory adoption of an official vocabulary of code words would tend to restrict the use of the cable as an instrument of trade. Moreover, exporters say, a new vocabulary will do away with numberless private codes consisting of "made-up," or spurious words, in that they are not to be found in dictionaries of any language. The Bureau of International Telegraphs at Berne adopted the "vocabulary" accepted by the convention in 1896 and which contained 250,000 words. The "vocabulary" now in use has as many as 1,250,000 words. The larger "vocabulary" has come into vogue because of efforts at condensation. The telegraph conference which meets this year in London is long overdue.

THE SOUTHERN CALIFORNIA ELECTRO-MEDICAL SOCIETY has been organized in Los Angeles, Cal., with a large membership of physicians, who have made a special study of electrical science as applied to the practice of medicine and surgery. Dr. O. Shepard Barnum is president and Dr. A. O. Conrad is secretary. The society will meet on the first Tuesday evening of each quarter, when exhibitions and demonstrations of new instruments will be made, to keep members up-to-date in the use of electrical appliances.

LIGHTING BIG BEN.—This celebrated big London clock is having the dials on each of its four sides illuminated with 60-cp Nernst lamps. The clock was formerly lighted by gas jets, twenty-four being used to each dial, and on each 365 nights of the year a man had to climb up and light each of these 96 jets. Two men are still required to wind the clock, spending three afternoons of each week for the purpose. A motor might help. Big Ben is considered reliability itself, and the average Londoner would as soon think of the world ceasing to revolve on its axis as to imagine the hands of this clock failing to move around its dials unceasingly night and day. Except for a short time once in fifteen years, when the clock has a short rest in order that it may receive a thorough cleaning, it has "marked time" for the Empire and the British Parliament

BROOKLYN RAPID TRANSIT.—Mr. W. B. Parsons, chief engineer of the Rapid Transit Commission of Greater New York, has presented a plan to improve Brooklyn conditions, which may be summarized as follows: A second tunnel from Maiden Lane, New York City, to Nassau and Orange Streets, Brooklyn, to handle the elevated railway traffic, by means of connections with the Manhattan and Williamsburg Bridges. The removal of all elevated trains from the present bridge, trolleys to be operated on the elevated tracks, and the roadways used for vehicle traffic. A four-track subway from Flatbush and Atlantic Avenues to Prospect Park, a three-track subway under Eastern Parkway to East New York Avenue, and a two-track route in Flatbush Avenue to East Broadway. A combination subway and elevated route from Flatbush and Atlantic Avenues to Fort Hamilton, with a third tunnel under the East River, from Atlantic Avenue to Whitehall Street, New York City. Extensions and improvements in the elevated system of the Brooklyn Rapid Transit. Total number of miles of new road proposed by new plan, 37; total trackage, including new routes and extensions, 120. Estimated cost, $52,000,000.

LETTERS TO THE EDITORS.

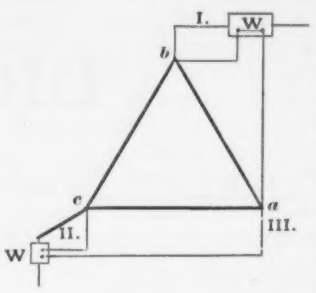
Three-Phase Measurements.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 14 I have seen that the question on the "Three-Phase Measurements" has been revived, and have read with great interest the preceding articles by Mr. A. S. McAllister and L. L. Perry. The subject is a very important one and Mr. McAllister has done well in bringing it forward; however, permit me to observe that the discrepancies and the uncertainties to which he alludes in no way exist.

In the first place, the "power factor" must be distinguished from the "angle of lag" (leaving aside the case of a leading current). Frequently the cosine of the latter has the same value as the "power factor" and is a most convenient representative of it; but, generally speaking, they are not one and the same thing. As it is universally known, the angle of lag is the angle formed by the two vectors representing in magnitude and phase a current and an e.m.f., while the power factor of a circuit is the ratio between the true watts and the apparent watts of the same circuit. Consequently, the power factor has always, in every circuit, a single and determined value, since the true or apparent watts have always, in every circuit, a single and determined value. In fact, by "apparent watts" of a circuit (this denomination, "apparent watts," is obviously a reference to the direct-current phenomenon) we understand the sum of the products of the e.m.fs concatenated with the circuit, times the currents by them generated upon the reactances to which they are applied (referring to effective values of the sinusoidal quantities). As to the true watts, they can be measured—taking the original case of a three-phase system—with three or two wattmeters. That two wattmeters are sufficient we can, leaving aside the well known mathematical demonstrations, readily conceive by the following:

The wattmeter, *I*, reads the current, *I*, and pressure, *a b;* but the current, *I*, is the resultant of the currents of the legs, *a b* and *b c;* therefore, the wattmeter, *I*, reads the power of the leg, *a b*, plus the fictitious power of the current of *b c* and pressure, *a b*. Analogously, we see that the wattmeter, *II*, reads the power of the leg, *a c*, plus the fictitious power of the current of *b c* and pressure, *a c*. Summing up algebraically the readings of the two wattmeters, we will have the power of the phase, *a b*, plus the power of the phase, *a c*, plus the power of the current, *b c*, and pressures, *b a* and *a c;* that is to say, of their resultant, *b c*, which actually constitutes the power of the third phase, *b c*.



THREE-PHASE MEASUREMENTS.

Any other combination, not analogous, of two wattmeters will not suffice to record the power of the three phases. We thus know the "apparent watts" and the "true watts" of the circuit. Their ratio is the power factor of the circuit, no matter how unbalanced it may be.

For instance, referring to McAllister's particular case, the "true watts" are 6,000, and the "apparent watts" are $100 \times 10 + 100 \times 20 + 100 \times 30 = 6{,}000$. Therefore, the power factor is $\frac{6{,}000}{6{,}000} = 1$.

Any other method for obtaining the power factor is not general; no wonder, therefore, that it is not applicable to all cases. For instance, the formula, $tan\ \Theta = \sqrt{3}\ \frac{W_{bc} - W_{ac}}{W_{bc} + W_{ac}}$ is deduced by working out the two formulas:

$W_{ac} = \sqrt{3}\ Ei\ cos\ (30° + \Theta)$,

$W_{bc} = \sqrt{3}\ Ei\ cos\ (30° - \Theta)$, and eliminating E and i, on the assumption that i and E are the same in both formulas—that is to say, that the system is balanced; thus, if $cos\ \Theta = 1$, the formula gives $W_{ac} = W_{bc}$.

Furthermore, in the power factor, $\frac{W}{\sqrt{3}\ I\ E}$, the denominator plainly shows that the formula applies only to balanced circuits, in which case it would give both the power factor of the system and the "angle of lag" of the currents behind their e.m.fs. But this formula, as the preceding one, if used in case of unbalanced circuits, gives results such as to render them useless. There is a case, however, that better shows the possible difference between power factor and angle of lag. This is when the three phases of the circuits have different values of *cos* Θ. In such a case the power factor of the whole system has always the usual value above mentioned, but what is the "angle of lag?" It is the same as asking, "what is the current of an unbalanced three-phase system?" It is necessary to mention the amperes flowing in each lag. In the same way, in our case we must find the *cos* Θ of each phase, reading for each one of the volts, amperes and watts; but we cannot represent the power factor of the whole system by the cosine of an angle, and have it retain any practical significance. In this case it is even impossible to use the graphic representation of Mr. Perry as he has illustrated it, because the Y of the currents would be distorted and it would be impossible to superpose it on the Y of the pressures.

G. FACCIOLI.

NEW YORK, N. Y.

Taxation of Lighting Plants in Michigan.

To the Editors of Electrical World and Engineer:

SIRS: I have gone over your analysis of the annual report of the Public Lighting Commission of Detroit carefully, and find you have covered the field thoroughly. Your handling of this report shows that you were well informed of the local Detroit conditions, and I doubt if anyone could have analyzed it as well, certainly not better.

There is only one suggestion that I can make and that is in regard to the amount allowed for lost taxes in the Commission's report. This amount is very much too small. The fact is the State Tax

Commissioners in the last two years have raised the taxes on every lighting and power plant to the limit. They claim the property should be assessed for what it will bring in the market. If the amount you suggest should not be practically equal to the sum of your capital stock and bond issue, they promptly assess you for this total, and summon you to show cause at some subsequent meeting why you should not pay taxes on the amount so arrived at. The hard part of this lies in the fact that the State Tax Commission of Michigan is a law unto itself, there being absolutely no redress. You can protest until you are black in the face, but to no avail.

In my opinion, if the Detroit municipal plant was assessed on the same schedule that all Michigan electric plants are, their amount would be nearer to $700,000 than it is to $400,000.

Saginaw, Mich. A. G. Moser.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alternators in Parallel.—Benischke.—An article on the theory of surging of alternators operated in parallel. Goerges has given a theory based upon the assumption that this is a resonance phenomenon which may be considered as analogous to acoustic resonance. The present author claims that this analogy is improper because the acoustic vibrations are strongly damped and because the reaction of the vibratory systems upon one another is not taken into consideration. He gives an outline of a mathematical theory of the phenomenon.—*Elek. Zeit.,* March 12.

REFERENCE.

Operation of Alternators in Parallel.—Manduit.—An illustrated summary of recent papers by Rosenberg, Benischke, Goerges and Goldschmidt on this subject.—*L'Eclairage Elec.,* March 7.

Lights and Lighting.

Nernst Lamp.—A long note stating that the Reichsgericht (the highest German court) has reversed the decision of the lower court in the suit between the General Electric Company of Berlin and Boehm concerning the validity of the fundamental Nernst lamp patent. This patent is now upheld. The progress of Nernst over Jablochkoff is explained in the decision.—*Elek. Zeit.,* March 12.

Small Economical Arc Lamp.—Some notes on a small arc lamp devised by an Italian engineer, Rignon, and acquired by the General Electric Company of Berlin. On account of pending patents no details are given, but it is stated that this arc lamp has about the size of a Nernst lamp for 1 amp. It is an enclosed arc lamp and the main feature appears to be the use of impregnated carbons (like the carbons in the Bremer arc lamp); the impregnation of the carbons is said to have two very important results: first, it increases the illumination obtained per unit of power, and second, it prolongs the life of the carbon. The regulating mechanism is said to be very simple, so that a small and very economical lamp is produced, the light from which is said to be more steady than that of other enclosed arc lamps. The life of the carbons, which have a thickness of about 1 mm, is 20 hours; the power consumption is 0.6 watt per candle-power. Rignon states that the lamp can be made from 50 cp upwards, the selling price being not over $5.00.—*Zeit. f. Beleucht.,* February 28.

Theatre Lighting.—An illustrated description of the lighting installation of the New Theatre in London. Current is furnished by a supply company at 100 volts, the three-wire system being split outside the theatre, so that there is never a difference of potential of 200 volts between adjacent mains in any part of the house; the two main distribution boards and switchboards on the stage and the other in the front of the house, are each supplied from two distinct and separate pairs of mains. On the stage there is provision for over 1,000 lights and 13 arc projectors. The whole of the stage wiring is repeated four times over, in white, amber, blue and red; the arrangements for controlling the stage lighting have been specially designed, the whole of the prompter side of the flies having been given up to the electrical plant. The main stage board, the dimmer gear, the dimmers themselves, the arc lamp resistances and the controlling resistances for the ventilating fuse are all situated thereon, so that the engineer in charge has never to move from the fly-rail during the performance should any hitch occur. The dimmers are of the Lyons liquid resistance type, and are mounted on insulating trays.—Lond. *Elec.,* March 13.

REFERENCE.

Incandescent Lamp Lighting.—Yorke.—A brief article comparing American and English practice. Americans favor lamps of 3 to 3¼ watts per candle, while the British favor 4 to 4½ watts, because the latter have a longer life. He shows that the British practice is quite uneconomical.—Lond. *Elec. Rev.,* March 6.

Power.

Steam Power Versus Hydraulic Power.—Hecker.—An article in which he discusses the prospects of a proposition made in a special case in practice, to erect a hydraulic installation which, if all the available water is utilized, would give a power of 600 hp. The cost of the hydraulic plant alone without the electric plant is estimated at about $375,000. The cost of a steam plant of the same capacity is estimated at $100,000. As the cost of operation is higher for the steam plant than for the hydraulic plant, the question arises under which conditions the one is financially more economical than the other. The author discusses this question under the following supposition: Interest in both cases, 4 per cent.; depreciation in both cases, 1 per cent. of first cost of installation; deterioration, 5 per cent., and 2 per cent. of first cost for the steam and the hydraulic plant respectively; maintenance, 2.5 and 15 per cent. respectively. The price of coal is assumed as ½ per cent. per kgm; the steam consumption as 9 kgm per effective horse-power-hour; the cost of fuel consumed per horse-power-hour, 0.75 cent. The cost of cleansing, oiling, packing, etc., materials, is assumed to be 0.036 cent per horse-power-hour more in the steam plant than in the hydraulic plant. The wages are assumed to be $1,500 more per year in the steam plant than in the hydraulic plant. Under these suppositions, the author reaches the conclusion that the hydraulic plant is more economical than the steam plant only when a load factor of more than 60 per cent. is generated during the total time.—*Elek. Zeit.,* February 19.

Greek Transmission Plant.—A long illustrated description of the light and power installations of Athens and its harbor town, Piræus. The main generating station is situated near Phalberos and contains direct and alternating-current generators and exciters. The direct-current dynamos are 750-kw, 600-volt machines and supply current to the tramway between Athens and Piræus, in the vicinity of which road the power plant is situated. The alternators give 5,500-volt, three-phase currents and supply three transmission lines, which will be mentioned below. Besides these main generating sets, there are auxiliary steam-driven sets, each consisting of an engine, on the axle of which are mounted a 75-kw, direct-current machine for the excitation of the alternators, and a 75-kw alternator for transmitting energy to Piræus for lighting the harbor and cities during the hours in which the main sets are not running. There are three transmission lines, the shortest one being overhead throughout and having a length of 1 km and supplying the converter sub-station of Phalerus from which the 230-volt, direct-current, three-wire network is supplied. The second transmission line is throughout overhead and has a length of 2.7 km and supplies the sub-station of Piræus, which furnishes current to 70 arc lamps in series for lighting the harbor and also current to a three-wire network for lighting the city. The third transmission line has a length of 7.8 km and supplies the two sub-stations of Athens; 6.3 km, i. e., from the plant to the suburbs of Athens, is overhead, and the rest is underground cable. In the first sub-station the 5,500 three-phase currents are converted partly by means of transformers and 200-kw synchronous converters into

250-volt direct current for lighting purposes, and partly by means of transformers and 250-kw synchronous converters into direct current for the tramways between Athens and Piræus. This sub-station also contains two storage batteries; one of 3,400 amp-hours' capacity works in parallel with the converters for lighting, the other of 900 amp-hours' capacity serves for traction. The load in the second sub-station in Athens is extremely variable and for this reason motor-generators with synchronous motors have been installed, which permit of a wide regulation of tension by means of exciting rheostats. The synchronous motors have 70 kw capacity, and the coils are wound directly for 5,500 volts; they receive the current from the first sub-station; the direct-current machines give normally 60 kw at 250 volts. This second sub-station supplies the lighting network of Eastern Athens. The total installation has to govern the following amounts of power for various purposes: 400 kw for lighting of Athens, 950 kw for traction between Athens and Piræus, 250 kw for lighting of Piræus, 60 kw for lighting of Phalerns, 1,200 kw for lighting of Kiphissia and for traction between Athens and Piræus.—*L'Ind. Elec.*, February 25.

REFERENCES.

California.—A well-illustrated article on the systems of the United Electric Gas & Power Company, with detailed descriptions of the plants at Santa Barbara and Santa Monica.—*Jour. of Elec.*, January.

Los Angeles.—Low.—A very long, exhaustive and profusely-illustrated article on the generating, transmission and distribution systems of the Edison Electric Company, of Los Angeles, Cal.—*Jour. of Elec.*, January.

South Yuba.—Van Norden.—A long and profusely-illustrated description of the water and electric systems of the South Yuba.—*Jour. of Elec.*, January.

TRACTION.

Third Rail.—Young.—An article on the third rail on the Baltimore & Ohio Railroad, and an account of the reasons for changing from the overhead to the third-rail construction, and the methods followed. Electricity is used for hauling the steam trains, including the locomotives, weighing about 90,000 pounds each, through a tunnel in the City of Baltimore. The third rail weighs 43 kgm per meter and is mounted on a reconstructed granite insulator, which is carried on a malleable-iron stand, which also has upright standards at the sides for supporting the wooden guards. A construction in the station first installed was one in which the shoe ran along the under side of Z-bars, which carried the current. This was changed to another form which is illustrated. At certain points it was found necessary to provide a third rail, which could be lowered to allow steam engines to pass over it and afterwards raised to give contact to the electric locomotives. The methods of accomplishing this and views of the movable third rail itself are illustrated. The shoe is attached to the bumper block of the locomotive and is mounted on a vertical sliding rod, so that it can have an up-and-down movement, while springs allow a horizontal movement. The shoe is prevented from dropping too low by a bolt on the sliding rod. The up-and-down movement is 2½ in. and the horizontal movement is 1¾ in. on each side of the central support. The entire weight of the sliding rod, shoe and all attachments is 150 lbs., and this weight is necessary on account of the large currents required by the locomotive. The wearing part of the shoe is steel with a flat surface 4 in. wide by 20 in. long. On straight track the third rail is alive all the time, but in stations and switch yards a sectional conductor is used with electric switches; there are 26 sections. The design of the switch was an important consideration, as it had to be able to open and close circuits of from 500 to 2000 amp with reliability and without sparking. It must also be able to close the circuit and keep it closed with a small current. The current used for closing the circuit in the switch is 25 amp, or about one-hundredth of the maximum current carried by it. As at present employed, the switch will operate at any voltage between 175 and 700, which latter is the voltage used on this line. Magnetic blow-outs have been installed on the main jaws of the switch and also at the final point of break of the arc, as the circuit is broken in three places. Other details of the switch are described. Another feature of the sectional conductor system is the method of closing this switch. Originally storage batteries were used, but the method now employed is to use a small generator on the locomotive, driven by a compressed-air motor. This motor is supplied with compressed air from the same tanks which are used for the air brakes. When the pressure at the tanks falls below a certain limit and current is being received from the third rail, the generator is run as a motor and the compressed-air motor acts as an air compressor to supply air to the compressor.—*St. R'y Jour.*, March 14.

Third Rail.—An editorial discussion of third-rail supports, the necessity of providing a strong mechanical as well as good electrical support being pointed out. Current will inevitably leak from the third rail to the ground so that these supports will corrode more quickly than if not under electrical strain; hence, substantial construction is necessary. Moreover, it will undoubtedly be necessary to use considerable pressure on the shoe which slides on the third rail to remove the ice and sleet, so that this is another reason against poor construction.—*St. R'y Jour.*, February 28.

Electric Railway Practice on the Continent of Europe.—Vellguth.—An article in which he briefly discusses electric railway practice in the continental countries of Europe outside of Germany, Switzerland and France, which were discussed in a previous article. The writer refers to the extension of electric traction in Austria, and states that in November, 1901, there were 27 electric lines in that country, the most extensive being in Vienna. This city, when all roads are electrically equipped, will have 200 miles of track. Part of this system is equipped with the bow trolley and part with the conduit. The writer also refers to the Vienna Lokalbahn and to the Stadtbahn. Some particulars are also given of a short three-phase railway at Wollersdorf on which 3,000 volts are used. The principal electric roads in Hungary are in Budapest, which was the first city to introduce the conduit system on a large scale. Particulars of these roads are given, as well as of the Franz Josef Underground Railway, which is 3.7 km in length. Italy has done a great deal in electric traction, especially in the direction of the equipment of the steam roads with electric power. The city systems do not differ in any material respect from those in other countries. Denmark contains electric railways worthy of mention only in Copenhagen. The companies in this city are under very strict municipal regulations, some of which are mentioned, and at one time allowed only accumulator cars. The double trolley has been used to a considerable extent in that city through the fears of the authorities in regard to electrolysis. The conditions in the other European countries are then briefly summed up.—*St. R'y Jour.*, March 7.

Sub-Station Practice.—An article on the sub-station practice on the Toledo & Western Railway; the sub-stations are of small capacity and are located in passenger and freight stations, where the station agent looks after the machinery; the machinery is examined by a skilled man only occasionally. This reduces the cost of inspection. No serious difficulties have been experienced, and if a breakdown occurs in one station it does not seriously interfere with the operation of the road, as there are a large number of sub-stations. The road also makes use of a portable sub-station which consists of a rotary converter, transformers, etc., mounted in a car, which can be run to any part of the line desired.—*St. R'y Jour.*, March 14.

REFERENCES.

Single Motor Tram Cars.—Wilkes.—An article in which the writer says that there are many tramways on which the requirements of the schedule hardly ever call for the use of the parallel combination of motors. He tries to make out a case for the four-wheel single motor truck with simple rheostatic control, as against the eight-wheel maximum traction car. The advantages claimed for the former are decreased first cost of the electrical equipment and increased economy of power.—Lond. *Elec. Rev.*, March 6.

Collector Shoe and Sleet Cutter.—A description of a device made of eighteen plates in the form of sectors of a circle. The plates dove-tail together and are supported from alternate ends and are hinged at the center. The object of the shoe is to cut the sleet and ice from the third rail. Only one shoe of this type has been built and it is being tried on the Manhattan Elevated.—*St. R'y Jour.*, March 21.

Chipping Ice from the Third Rail.—The writer recommends a reciprocating pneumatic chipper to remove the ice instead of the usual brushes.—*St. R'y Jour.*, March 14.

Fighting Sleet and Snow on a Third Rail.—A description of the methods used on a third-rail road in Grand Rapids. The scrapers employed were tie-plates, the base of which has sharp corrugations. This road has found these steel scrapers more desirable than brushes, although a rattan brush follows the scraper to remove the broken ice from the rail.—*St. R'y Jour.*, March 14.

Street Railway System of Havana.—A review of the electric railways of Havana. The principal line owns about 36 miles of track and 110 cars, and is equipped with the double trolley. The same company is also planning another system in the neighborhood of Havana with 100 miles of track.—*St. R'y Jour.*, March 21.

Rothesay.—An illustrated description of the trolley line of Rothesay, Scotland; the extent of the line at present is 2½ miles double-track.—Lond. *Elec. Rev.*, March 6.

Telephony for Railways.—Soulier.—An illustrated description of the Basanta system of telephonic intercommunication between trains while running.—*L'Ind. Elec.*, February 25.

Installations, Systems and Appliances.

Dangerous Rise of Voltage Due to Resonance.—Finckh.—A description of a case in which a dangerous rise of voltage was observed in a 2,000-volt, 1,000-kw, three-phase generator; the 4-mm thick mica insulation of the armature winding was broken through at a certain place and the coil was burned, there being simultaneously a formation of strong sparks from which the existence of very high voltages could be concluded. It was found that at the same time there existed a variable earth in the high-voltage network. It was also observed that when the stator iron of this machine was touched, heavy shocks were felt. Both facts were found to be interconnected. The earth fault destroys the symmetry of the potentials of the terminals against earth and causes in the machine a changing current from the stator iron to earth. On the other hand, the shocks received in touching the other stator iron indicated that between the same and the earthed machine frame, there was an insulating layer, perhaps of dust or dirt. The charging current due to the earth fault could not flow directly to earth, but had first to pass this insulating layer and there formed a spark gap. He states that it may be considered to be a general rule that whenever there are resonance phenomena which cause a dangerous rise of voltage, there are always spark gaps also, and threfore, currents of high frequency and comparatively small wave length. In the present case this was proved by short-circuiting the spark gap, i. e., by connecting the stator iron with the frame; a charging current flowing from the stator iron to earth no longer caused serious sparks in the armature, which, however, appeared again when the metallic connection between stator and frame was broken. This metallic connection was, therefore, definitely adopted and since that time no trouble was experienced with the machine.—*Elek. Zeit.*, March 12.

British Power Plant.—The first part of an illustrated description of the Trafford Park power supply plant. Besides the lighting load, considerable power is used in connection with the docks and warehouses. The price charged for electric power is very low, viz.: 3 cents per unit for the first 1,200 hours of maximum demand per year and 1 cent per unit for all further units; this is calculated on a basis of a regular load of 54 hours per week; for lighting, 8 cents charged per unit for the first 400 hours of maximum demand per year, and 3 cents per unit for all further units. The power plant contains three generating sets, each of 1,000 hp; two are direct-current machines and the third a double-current generator; the latter is said to be the largest installed in England up to the present day. Direct current is generated at 500 volts and alternating current is obtained from the 20-pole, double-current generator at 340 volts three phase and a frequency of 30 periods per second. It is arranged for mining, either as a shunt or a compound machine, as required; when running compound the e.m.f. is constant at 550 volts for all loads. The boiler house contains two sets of electric pumps in which the motors have double-wound armatures and are regulated on the series-parallel control system.—Lond. *Elec.*, March 13.

Charging High-Tension Cables.—Woodhouse.—A communication referring to the note of Garrard, recently abstracted in the Digest. He says that a charging device such as that mentioned by Garrard has been used and given up on several transmission lines, as an unsatisfactory arrangement. To safeguard a high-tension system, he recommends using spark-gaps of the Wurtz type and to put plenty of metal in them; not to use step-up transformers at the generating end, but if they must be used, to do the switching on the high-tension side; not to use an alternator which gives a wave form differing considerably from a sine curve.—Lond. *Elec.*, February 27.

Rules and Regulations.—An editorial giving a review of the work done since 1894 by the special committee appointed by the German Association Electrical Engineers for drawing sets of rules and regulations. Up to 1897 two sets of regulations had been issued, one for low-tension (below 250 volts) installations, the other for high-tension (above 1,000 volts) installations. A set of regulations for medium-tension (between 250 and 1,000 volts) was issued in 1899; regulations for tramways in 1900. It was then decided to issue only two sets of rules—for low-tension and for high-tension—instead of the three—for low, medium and high-tension—for electric installations in towns, and issue also special regulations for theatres and mines, and safety rules for the protection of workingmen. This programme has now been completed. These regulations have now been accepted and will go into force on January 1, 1904, with the exception of the safety rules for the protection of workingmen, which will go into force on March 1, 1903. The same issue contains, on more than 14 full pages, the full text of the following regulations. Regulations for low-tension installations, low-tension being defined by the rule that the effective voltage between two conductors, which are insulated from earth, should be not more than 500 volts, and that the effective voltage between any conductors and earth should not be more than 250 volts; regulations for high-tension installations, high tension being defined by the rule that the effective voltage between any conductor and earth is more than 250; for storage batteries the discharge voltage is the decisive figure. Safety rules for the protection of workingmen. The special rules for theatres are included in the regulations for low-tension installations, the special rules for mines are included in both the regulations for low and for high-tension installations. There is also published a proposed set of rules for erecting and maintaining the poles for transmission lines in "strong current" or "heavy" electrical engineering ("Starkstromanlagen"), i. e., excluding telegraphy and telephony; the term "heavy" electrical engineering was used by Swinburne in his presidential address and has since been used by others. —*Elek. Zeit.*, February 19.

References.

British Lighting Plant.—An illustrated description of the electric plant of Barnstable. It contains three 125-kw, 500-volt, direct-current dynamos and a storage battery of 240 cells. The three-wire system is used, the supply pressure being 230 volts for lighting and 230 or 460 volts for power.—Lond. *Elec. Rev.*, March 6.

Large Capacity Switches.—Hewlett.—A profusely-illustrated description of the various types of large capacity switches used in electrolytic work.—*Electrochem. Ind.*, March.

Electro-Physics and Magnetism.

Electrodeless Discharges.—Davis.—An account of an investigation of the conductivity produced in gases at various pressures when an electrodeless discharge passes through them. Special care was taken to secure an absolutely uniform discharge potential, and this was attained by a spark micrometer immersed in hydrogen and inserted in a shunt circuit. The vacuum vessel consisted of two coaxial cylinders of the boiling tube pattern, with their upper rims welded together so as to leave a cylindrical space between them; they were surrounded by a coil of wire having the same axis, which coil is necessary for producing the electrodeless discharge; to measure the ionization produced by the same, ring electrodes were mounted in the upper and lower portions of the vacuum. At ordinary pressures the conductivity produced is very small, with decreasing pressure it rises suddenly to a maximum at about 0.6 mm, remaining at that maximum up to 0.04 mm, and falling suddenly to zero at 0.03. The energy absorbed increases in a somewhat similar manner. The oscillations in the circuit are damped by this absorption, and the heat thus produced in the vessel is enough to heat a platinum wire to a white heat.—*Phys. Zeit.*, February 15; abstracted in Lond. *Elec.*, March 6.

Radio-Activity and Gravitation Energy.—Forch and Kucera.—Two articles referring to Geigel's recent paper in which the author tried to prove experimentally that the energy given out by radio-active substance is equivalent to a loss of gravitation energy. Kucera shows that Geigel's mathematical calculation is incorrect. Forch has repeated Geigel's experiments under modified conditions in which, if there is really an absorption of gravitation energy, he ought to have obtained 40 or 50 times the effect obtained by Geigel, but his results were negative.—*Phys. Zeit.*, March 1.

Induced Actinium Rays.—Debierne.—An account of experiments showing that while an induced radio-activity can be obtained not only from radium salts, but also from actinium salts, yet the character of the induced radio-activity allows of a clear distinction between the effects of the two substances. The activity induced by

radium is sensibly uniform in its distribution throughout the vessel, while that due to actinium is practically confined to the immediate neighborhood of the active body. Radium requires an open space to induce its radio-activity upon a second body, while actinium requires a very narrow space. He believes with Curie that these substances send out "activating ions" which lose their activating power rapidly in the case of actinium and slowly in the case of radium. Thorium stands in this respect between the two.—*Comptes Rendus,* February 16; abstracted in Lond. *Elec.,* March 6.

Sensitiveness of Tissues to Radium Rays.—Danysz.—An account of an investigation of the effect produced by radium rays upon the skin. A radium preparation applied to the skin produces no immediate effect, but leads to the development of a very painful gangrene within 8 to 20 days. Different tissues are sensitive to very different degrees. A radium preparation, 500,000 times as active as metallic uranium, produces an effect upon the human skin after a few minutes. The same preparation applied to the skin of a guinea pig for 24 hours produces the complete destruction of the epidermis and dermis, but if applied below the skin the effect upon the skin is much reduced and very little effect is produced upon the underlying tissues. Of the latter the nerve tissue is the most sensitive; it is well protected by the bones of the spinal column.—*Comptes Rendus,* February 16; abstracted in Lond. *Elec.,* March 6.

Selenium.—Giltay.—A description of improved lecture apparatus for exhibiting the sensitiveness to light. Referring presumably to some former apparatus, he substitutes a glass plate with six windows for the ebonite plate with eight windows for intermittent illumination, and makes the dark intervals somewhat larger than the light ones on account of the lag in the light effect. Another species of intermittent illumination is produced by mounting a radiometer in the path of the beam. The author uses one with eight vanes, and obtains a good effect in the telephone. The illumination may also be made intermittent by means of a marometric flame. The best for the purpose is an acetylene flame, but in order to increase the effect the author uses three such flames side by side worked by the same membrane. It is then possible to make the distance between the selenium cell and the flame as much as 10 cm, and thus save the former from injury by heat. He finally warns against an effect he has observed when the circuit containing the selenium cell, battery and telephone is broken. The extra current then induced often short-circuits the selenium cell, and to avoid this he shunts the cell by means of a commutator in which he inserts a plug before breaking the circuit.—*Phys. Zeit.,* February 15; abstracted in Lond. *Elec.,* February 27.

REFERENCES.

Resonance in Electric Circuits.—Field.—The first part of an illustrated paper on a study of the phenomenon of resonance in electric circuits by the aid of oscillograms. He discusses the conditions under which electrical resonance may occur with one of the higher harmonics of the e.m.f. wave of the 2,500-kw, 6,000-volt, three-phase Glasgow municipal tramway generators. A series of curves is reproduced which are taken by means of a Duddell high-frequency oscillograph and synchronous motor-driven mirror.—Lond *Elec. Rev.,* March 6.

Magneto-Friction.—Pellat.—A French Physical Society paper on the resistance of magnetic fields to the passage of cathode rays across them. It is necessary to assume that the anode or cathode flux experiences in a strong magnetic field a resistance of a frictional character, which is zero or very feeble along the lines of force, and considerable in a direction at right angles to them.—*Bull. Soc. Fr. de Phys.,* February 20; abstracted in Lond. *Elec.,* March 6.

Electro-Chemistry and Batteries.

Electrolytic Preparation of Iodoform from Acetone.—Abbott.—An account of a series of experiments made to find the best conditions for this purpose. They were found to be as follows: A current density of not more than 1.35 amp per square decimeter, a temperature of 75° C., with an anode solution consisting of six grammes of sodium carbonate, 10 grammes of potassium iodide, 100 cc water, and 5.5 cc acetone added at the rate of 0.5 cc per 10 minutes during electrolysis. These gradual additions are necessary, as in order to keep the acetone from oxidizing and from forming condensation products, only a small quantity must be present in the anode solution at one time.—*Jour. Phys. Chem.,* February.

Reduction Factors for Electrolytic Deposits.—Hering.—A table of numbers for determining the amount of any material formed electrolytically, from the amount given in other units. The figures have all been calculated from the legal weights and measures of this country. The author also points out a number of easily remembered approximate relations; for instance, 5½ pounds per day are almost exactly a ton of 2,000 pounds per year; or 5½ kgs per day are equal to 2 metric tons per year; every gramme per minute is about 3 pounds per day, or nearly 1½ kgm per day; a ton per year is about 1¾ grammes per minute; a metric ton per year is about 6 pounds per day, or ¼ pound per hour.—*Electrochem. Ind.,* March.

Steel Production in the Electric Furnace.—An illustrated description of the Stassano process, with a detailed account of the results of a test made by Goldschmidt. He reaches the conclusion that the electric furnace method of producing iron and steel can come into consideration everywhere where cheap water power and zinc iron ores are available. He thinks that for other countries, like Germany, the process could not compete with the usual metallurgical methods; for crucible steel, however, the case may be different; eventually the process might be used in such a way that ordinary pig iron would be refined in the Stassano furnace; but further experiments are still necessary to prove such a possibility.—*Electrochem. Ind.,* March.

REFERENCES.

Copper Refining.—Ulke.—An article giving notes on the history of electrolytic copper refining in America, and especially on the work of the Balbach Company. *Electrochem. Ind.,* March.

Electrochemical Development.—Krueger.—A summary of the development of the scientific and industrial electrochemistry during the year of 1902, giving brief references to articles published and patents issued.—*Electrochem. Zeit.,* January, February.

Industrial Electrochemistry.—J. B. C. Kershaw.—Continuations of his serial on industrial electrochemistry and electrometallurgy, giving brief notes on recent progress in Europe and America. The notes refer to the following: The Elmore electrolytic copper process; the calcium carbide patents; the use of electricity for glass manufacture; nickel production in Canada; new water power centers in America; the electric production of iron and steel; production and use of aluminum in the United States; electric laboratory furnaces; electric chlorates; electrogalvanizing; the works of the Ampere Electrochemical Company; electrochemical instruction in Germany; metallic sodium as a reducing agent; nitric acid and nitrates from the air; electrolytic antimony; peat-charcoal; barium and its compounds; purification of salt and brine; the efficiency of ozonizers; carbon disulphide.—*Elec. Rev.,* January 24 to March 7.

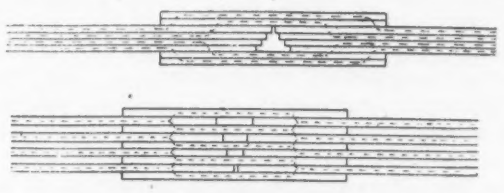
Electrometallurgy.—Beadle.—The conclusion of his serial on electrometallurgical problems, giving brief notes on iron, tin, tungsten, nickel, cobalt, mercury and antimony.—Lond. *Elec. Rev.,* February 27.

Acetylene Lighting for Small Cities.—An illustrated description of the acetylene central stations in Zinkau, Grieskirchen, Poechlarn and Strass in Austria.—*Zeit. f. Calciumcarbid Feb.,* February 13, 20.

Polishing and Plating.—Hawkins.—A continuation of his illustrated serial on the polishing and plating of metals. In this part he discusses various kinds of buffs, wheels, polishing materials, etc., and scratch brushes.—*Am. Jeweler,* February.

Units, Measurements and Instruments.

Testing the Magnetic Properties of Sheet Iron.—Brion.—An article in which he suggests some modifications of the method of Richter, which was described in the Digest last year. The principal advantage of Richter's and the present author's methods is that the iron sheets are tested as a whole, so that a value of the mean



FIGS. 1 AND 2.—TESTING THE MAGNETIC PROPERTIES OF SHEET IRON.

magnetic quality of the material is obtained, and it is this mean value which is alone of interest for the engineer. Fig. 1 represents the method by which Richter joins the ends of the plates together and makes a closed magnetic circuit, while the present author suggests instead the method shown in Fig. 2; in this the reluctance of

the air-gap is reduced to about one-fourth and the eddy current loss is also considerably diminished. He recommends the apparatus shown in Fig. 3; the test thus becomes very easy. The sheets to be tested are not bent at all; they are first placed into the two coils, then the wooden blocks, *A*, are introduced and afterwards the auxiliary sheets (shown at the left and right hand of the figure). With this arrangement the stray flux may be made very small. The influence of the two sets of auxiliary iron sheets is taken into consideration by determining the loss in them separately; these auxiliary sheets are covered with paper, except at the ends, where they overlap; these two sets are joined together so that they form a closed mag-

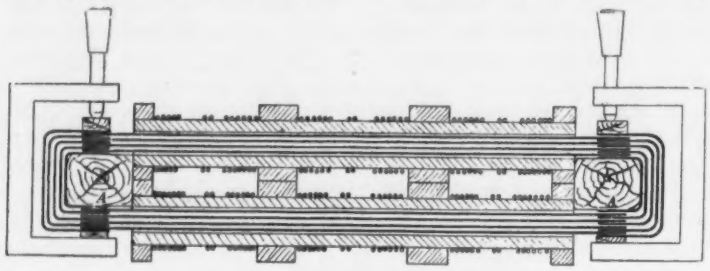


FIG. 3.—APPARATUS FOR TESTING.

netic circuit by the same method by which each set is joined to the sheets under test in Fig. 3; then the loss of the two sets of auxiliary sheets is separately determined. These auxiliary sheets may be considered the weakest point of the method, but the loss in them can be determined to any desired degree of accuracy; when sheets of 2 m length are tested and the distance between the upper and the lower sheets is 5 cm, the average length of an auxiliary sheet is 15 cm, i. e., 7.5 per cent. of the total length. The constancy of the auxiliary sheets should be tested from time to time.—*Elek. Zeit.*, March 5.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Fleming.—An abstract of a Cantor lecture on this subject. In discussing the question of the voltage obtainable at the balls, he showed by an experiment the great effect which the capacity of the air wire or connected condenser has on the spark length. The longer the spark in the air, the greater the pressure between the balls, so that greater voltages may be reached simply by increasing the spark-gap. But such a process, by increasing the resistance, finally causes the discharge to lose its desirable oscillatory character. A far better way of getting greater potentials has been used by Fessenden, who found that by allowing the spark to occur in a gas compressed to 20 atmospheres or more, the voltages attained are much greater for a given spark length, while, in addition, the breakdown is much more sudden. This increased suddenness in the breaking down of the air between the balls is found also to give greater radiating power to the connected air wire. When it is attempted to form a spark in air between two balls connected with an oscillation transformer whose primary is fed by the oscillations set up by an induction coil or alternating-current transformer, an arc is formed; for the purposes of wireless telegraphy the spark has to be separated out from this arc. He points out the importance of the oscillation transformer method in wireless telegraphy. In the first place, by storing energy in the oscillations in the primary circuit of the Tesla transformer (which circuit includes the winding, a condenser and a spark-gap) it is possible to radiate from the secondary a sustained train of waves; and in the second place, higher potentials are given to the radiating air wire. Thus more energy is stored on the air wire in each of its periods. The fact that in reality it is in the dielectric that the energy is stored, makes the design of the condensers of importance. To accommodate a given amount of energy the dielectric of condensers must have a certain bulk. The quantity of energy which can be stored electrically in a certain volume of a dielectric is much smaller than the amount it is possible to store mechanically. Thus, in a cubic foot of air only one foot-pound of electrical energy can be accumulated. From this point of view, one of the best commercial materials for condenser working is "micanite," a matted mass of mica and shellac, which has the advantage over glass, not only of storing two or three times as much energy, but also of being very free from flaws. On a simple air wire operated by an induction coil about one-fourteenth of a foot-pound in energy may be accumulated. When the spark occurs this is indicated in practically a single rush. He distinguishes the following types of Hertzian wave apparatus: the first is the early Marconi type in which the air wire was connected directly to one side of the spark gap; the second is the Braun type in which the air wire is attached to a freely oscillating independent circuit placed as a shunt to the spark gap; the third is the latest Marconi type in which the air wire is set into vibration by means of a second or further transformation.—Lond. *Elec.*, March 13.

Theory of Wireless Telegraphy.—Lecher.—An article in which he elaborates his theory of wireless telegraphy, according to which electric waves are transmitted along the earth's crust as waves are along wires. Signals could be transmitted in this way over the whole earth if it were possible to raise the potential of the earth a few volts; this could only be effectively done if the negative electrification could be removed to a point outside the earth; otherwise it would be impossible to construct condensers of capacities not very small in comparison with the earth's capacity. What the antenna or mast wire does in wireless telegraphy is some such action as that postulated. It conducts the opposite electrification away from the earth for some distance, say 150 ft., and conducts it back at the next reversal; its foot, therefore, gets charged positively and negatively in alternation, and these charges are transmitted at a rate depending on the dielectric constant and magnetic permeability of the earth. He suggests the following experiment: Let a wire be earthed at two points in a direct line from the antenna, and let its length be half the wave length of the oscillations; its ends will then be always oppositely charged and the maximum alternating current will pass through it. If placed at a right angle to the wave, it will show no response.—*Phys. Zeit.*, March 1; abstracted in Lond. *Elec.*, March 13.

References.

Wireless Telegraphy.—Arco.—A translation in abstract of his recent German article on a new method for tuning wireless telegraphy stations.—Lond. *Elec.*, February 27.

Wireless Telegraphy.—Wilke.—A translation in abstract of his recent German articles on the use of wireless telegraphy for military purposes.—Lond. *Elec.*, February 27.

Cable Ships.—The first part of an illustrated description of the two new British cable ships, *Restorer* and *Patrol.*—Lond. *Elec.*, February 27.

Trans-Pacific Cable.—McAdie.—A very well illustrated article on the laying of the American trans-Pacific cable.—*Jour. of Elec.*, January.

Miscellaneous.

Safety Clothes for Protecting Workingmen.—Artemieff.—An illustrated paper read before the Berlin Electrical Society. Two radically different methods may be used for protecting workingmen against fatal shocks: either the body is placed in an insulating cover (rubber gloves, etc.), or it is surrounded by a material of very good conductivity. The latter method is used by the author, who has devised a suit consisting of a very firm flexible metallic fabric with which the whole body, including head and hands, are covered. If this suit has a resistance of 0.002 ohm from one hand to the other, and if the resistance of the human body between the two hands is about 2,000 ohms, it is evident that only one-millionth part of the total current passes through the body. In his suit, which has a resistance of 0.002 ohm between the hands, he could stand continually a current of 350 amp, and for a short time 1,000 amp. The limits of current are given by the burning of the suit.—*Elek. Zeit.*, March 12.

New Books.

Elektrotechnik in Einzel-Darstellungen. By Dr. G. Benischke. Heft. 1, Die Schutzvorrichtungen der Starkstromtechnik Gegen Atmospharische Entladungen. Heft 2, Der Parallelbetrieb von Wechselstromaschinen. Braunschweig: Friedr. Vieweg & Son. 42 pages, 43 illustrations; 55 pages, 43 illustrations. Price each 1.6 marks.

The two pamphlets of which Dr. Benischke is the author treat of two very important subjects. The first describes the protective devices of power and lighting circuits against atmospheric discharges, and the second occupies itself with the parallel operation of alternators. The great experience of the author, who is chief engineer of one of the largest German electrical manufacturing companies, is a guarantee that his views will be of interest to electrical engineers, and especially to men in this country. It is of value for us to know what

is being done in Europe. While these pamphlets do not contain anything that will be new to the reading electrical engineers, they are a condensed review of the subjects they treat of, and will be found useful on that account.

Secondary Batteries: Their Theory, Construction and Use. By E. J. Wade. New York: D. Van Nostrand Company. 492 pages, 265 illustrations. Price, $4.00.

This is a most complete treatise on the storage battery, including, in addition to the lead-lead couple, the cells which have been brought forth from time to time having electrodes other than lead.

There are ten chapters, the first being a short introductory. The second, under the caption, "Historical," comprises 100 pages, and shows the evolution through which the lead accumulator has passed. Nearly every type and character of electrode that has been devised since the time of Planté is clearly shown. This chapter, together with Chapter X—the latter headed "Present Day Cells," and covering 90 pages—form a record of nearly every lead battery that has appeared on the market since the inception of the art. Chapter III describes those secondary batteries other than lead. Chapter IV is a discussion of the properties and behavior of lead cells. The charge and discharge reactions, variation of e.m.f. with acid density, change in capacity with changing conditions of output rate, influence of temperature, efficiency and internal resistance, are all fully discussed from a scientific standpoint, but no useful practical conclusions seem to be drawn from the discussions.

Chapter V is on the chemistry of lead cells. Here the author puts forth his "Polymerization Theory" of a large number of lead oxides being possible, forming a series of varying degrees of oxidization and producing correspondingly varying e.m.fs, and which theory he presented before the British Institution of Electrical Engineers in March, 1900. With this theory, however, the profession generally does not agree, as all the phenomena of a storage cell may be accounted for in much simpler and more probable ways.

Chapter VI is on the design of lead cells and Chapter VII on their manufacture. These are good, practical discussions, so far as they go. Definite methods of Planté formation and of making up active material mixtures are not given, though they are taken up in a general way.

Chapter VIII is on the treatment and testing of lead cells. Chapter IX covers erection and regulation of lead cells. This last is the only chapter in the book that essays practical information for the installing engineer. Two of the numerous successful booster systems are described, but no methods for calculation of sizes of machines or their windings are given. Altogether it is a work which shows a high order of knowledge and ability and is a most valuable book for such engineers as are engaged in storage battery design and production, though it is rather too theoretical to be of the greatest assistance to the practising electrical engineer.

Die Wechselstromtechnik. Edited by E. Arnold. Volume I, Theorie der Wechselstroeme und Transformatoren. By J. L. la Cour. Berlin: Julius Springer. 425 pages, 263 illustrations. Price, 12 marks.

A work on the theory of alternating currents composed by a writer of great ability cannot fail to attract attention even if it be written in a foreign language. The work of Mr. La Cour is a comprehensive treatise on the phenomena connected with alternating currents. It is divided into two parts, the first part dealing with the general theory of alternating currents, the second part dealing with the theory of the transformer for single-phase and polyphase currents, and with the theory of transmission of power by means of alternating currents. We cannot help expressing our admiration for the erudite manner in which the author has swept over the vast subject, but in doing so we cannot suppress our opinion that it would be possible to simplify the methods so as to make them more lucid and perspicuous, even if this would, here and there, lead to a sacrifice of generalization. It is, after all, a clear conception of the physical aspect of the phenomenon that we wish to impart to students and engineers rather than a general theory which covers every imaginable case, but which is baffling to a man not thoroughly familiar with every detail of the problems, the solution of which is covered by the general method. To the expert who is familiar with the subject of alternating currents, this book cannot fail to be an inexhaustible mine of knowledge, but as a treatise for the use of men whose time is naturally limited, whose knowledge has to cover not only the subject of alternating currents, but the whole vast subject of applied physics, this book will, we fear, be less useful than it would have been if it had been written with the understanding of what has been so pertinently called "The Economy of Science."

Most engineers are familiar with the use of differential equations, but few like to have these equations put before them without even so much as an assistance for solving them. We find, for instance, on page 36, the equation 22 is given as a solution of the preceding differential equation, instead of giving the necessary substitutions which would aid in the understanding of the solution. Such procedure is not conducive to the development of the understanding of the student. The subject of alternating current theory is treated admirably with the help of vector diagrams, the most recent contributions to this subject having been given due consideration. Thus the circle diagrams have received a great deal of attention, and the student who is painstaking enough to familiarize himself with these methods will certainly find them most useful in the solution of new problems. A large number of examples is given to illustrate the graphical methods. The use of theoretical methods in the treatment of engineering problems in this volume might have been greatly enhanced by the omission and cancellation of factors which have only a second or third-rate importance. Thus, in the theory of the transformer results can be obtained which are extremely clear and useful if the resistance of the primary winding is neglected, an assumption which can usually be made without introducing any serious error. Such assumptions greatly contribute to the understanding of a problem and make a theory useful which otherwise would be altogether too complex for application.

In treating of Fourier's theory, it might have been well if the author had given Prof. Clifford's method of deducing the coefficients of the various harmonics, a method which is not only very quick but also helps to understand the theory.

In treating of the measurement of power in alternating-current circuits, it is surprising that the author does not give the graphical theory of the wattmeter, which permits at a glance to understand a process which looks so abstruse if nothing else is given than the formulæ. It is marvelous how a simple subject can be presented in such a manner that it takes hours to obtain only a general understanding.

The most interesting chapter in the second part of the book is the theory of long-distance lines. It is surprising to find that the author derives the formula for the inductance of two parallel inductors, while he does not deem it necessary to give a derivation of the formula for the capacity of two parallel conductors excepting by giving the result based on the theory of Lord Kelvin's images which Mr. Steinmetz used in obtaining the constants for parallel conductors. In going back to the principles of electrostatics, it is easy to obtain direct without this artifice the formulas for the constants of parallel conductors; but as engineers are far more familiar with electromagnetic than electrostatic formulas, it would seem more necessary to give the derivation of electrostatic constants of long lines than the electromagnetic. The solutions of the differential equations for long lines are illustrated by plain diagrams, but, while the formulæ cover the problems pretty thoroughly, their interpretation should certainly have been enlarged upon as the complexity and importance of the phenomenon would require.

Directory of Electrical Societies, Etc.

American Electrochemical Society, Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

American Order of Steam Engineers, Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

American Street Railway Association, Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State, Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Iowa Electrical Association. Next annual convention, Davenport, April 8 and 9.

National Association of Manufacturers, Secretary, Marshall Cushing, 170 Broadway, New York. Annual convention, New Orleans, La., April 14, 15 and 16, 1903.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 26, 27 and 28, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

Electrically-Operated Printing Presses in England.

In the electrical operation of printing machinery, the principal difficulty to be overcome is in the matter of control. If large rheostats are used in series with the motors for controlling the same, much trouble is found in obtaining a sufficiently large number of contacts to give the motor a steady motion from step to step, and at the same time allowing sufficient area of contact to carry the total current of the motor at various speeds, without making the rheostat too large and clumsy. In some forms of rheostatic control for printing presses, as much as 90 per cent. of the current is wasted in the resistance wires when the machine is operated at very low speeds for adjustment and making ready. In some cases the main motor is not used for the very slow operation, another smaller motor being installed.

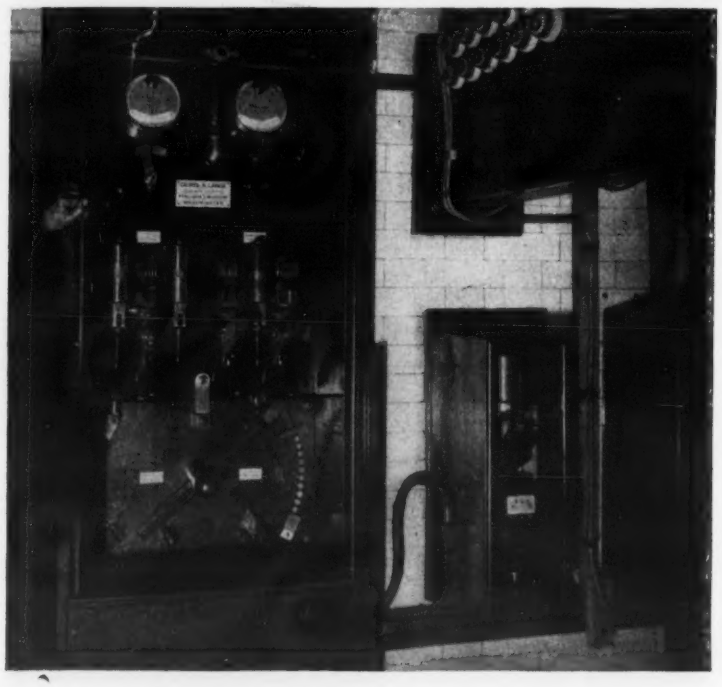


FIG. 1.—SWITCHBOARD.

The accompanying illustrations show the electrical details of an English printing press to which the Ward Leonard system of control is applied. The motor shown in Fig. 2 has a capacity of 62 hp and operates a sextuple Hoe press. Fig. 3 shows the controller connections as arranged for handling the motor under various conditions, and Fig. 4 shows the electrical connections, with the controller at the right. The plant was installed by Messrs. Geipel & Lange, of Westminster, for Messrs. Edward Lloyd, Limited, the proprietors of *Lloyd's Weekly, Daily Chronicle* and other publications.

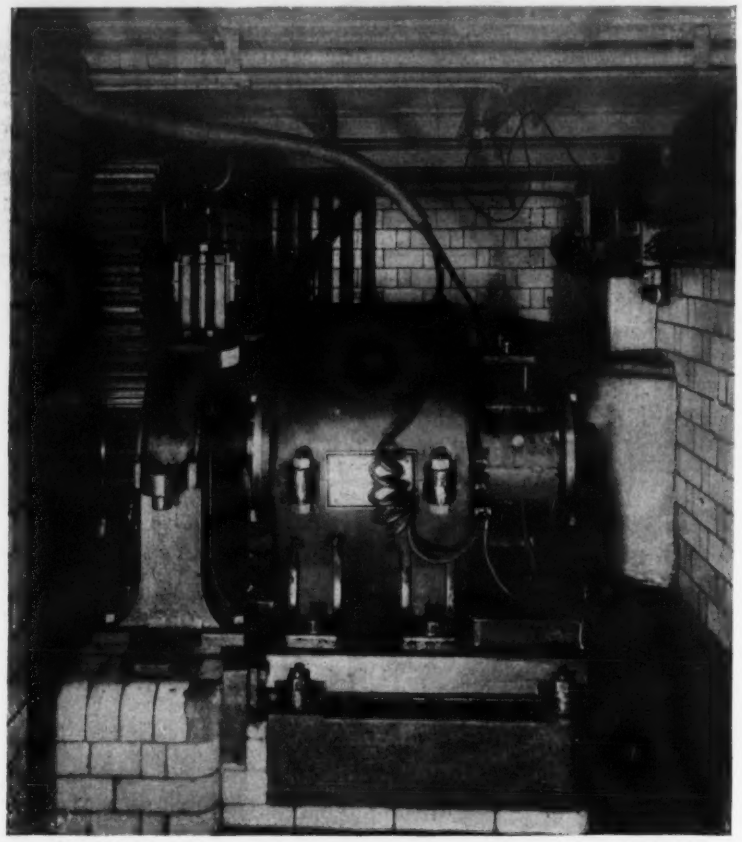


FIG. 2.—MOTOR FOR DRIVING PRESS.

With this equipment, which has been in operation almost two years, the press is started or stopped without jars or shocks of any kind and operates at very, very slow speeds for long periods without difficulty. The loss of power in regulation is stated to be less than 2 per cent., even at the lowest speed; this, of course, not including the loss in the motor-generator group. The press may be started from rest and accelerated to full speed with great rapidity and certainty, or it may be brought from a state of rest to full speed very gradually by hardly perceptible increments, and is absolutely under control at all speeds regardless of the load. If the electrical equipment is set to run at a definite speed and the load varies, the speed remains constant.

The latter consideration is one of considerable importance, for it is well known that the load on a printing machine varies from time to time according to the condition of the rolls and the ink, the pressure on the paper, the thickness of the blankets and the time the machine has been in operation, etc. With the series rheostat system, as the load varies, so do the controlling effect of the rheostat and the voltage at the motor.

The Ward Leonard system of control, as here applied, consists in delivering current to the press motor at a variable voltage suited to the precise speed at which the motor is running from time to time. For this purpose it is necessary to have a generator with a rheostat in the field thereof for varying the voltage. This generator may be driven by another motor, or by some external source, which may generate the whole of the electrical power required, or as in the case of Messrs. Edward Lloyd, Limited, only one-half thereof.

Here the generator is only half the size of the press motor and it is driven by another motor, which is also about half the size.

As will be noted in the diagram, Fig. 3, *A B* is a motor-generator, of which *A* is the motor and *B* is the generator, of 25 hp; the armatures of both are wound for 200 volts. *E* is the press motor of 50 hp, the armature of which is wound for 400 volts. *C* and *F* are the fields of the generator and press motor respectively. Both of these fields are separately excited and *C* has a reversible rheostat in circuit with it, having a large number of contacts. It will be seen

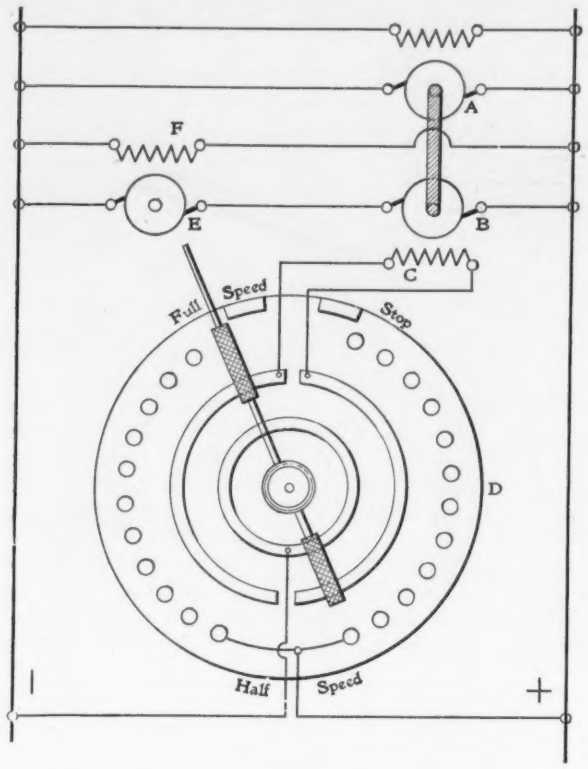


FIG. 3.—DIAGRAM OF CONTROLLER CONNECTIONS.

that the current supplied from the line to the armature of *E* passes through the armature of *B*, which runs continually at full speed. When starting up, the field, *C*, is fully excited, and the voltage of the armature is equal to that of the line, but in a counter direction. Consequently no current passes through *E*. The switch of the rheostat is now moved in a clockwise direction and a small resistance is inserted in the field, *C*, so that the armature voltage is slightly reduced below that of the line. A current sufficient for the full torque then passes through *E* and the motor begins to turn slowly.

To increase the speed more resistance is gradually inserted until there is no magnetism remaining in the field, *C*; the motor, *E*, then runs at half speed, the voltage being that of the line. By still further moving the switch of the rheostat in a clockwise direction, the field, *C*, is reversed and gradually strengthened. The voltage of the armature, *B*, is now gradually increased in a direction which assists the voltage of the supply mains, and as soon as the whole of the resistance is switched out, the voltage of the supply mains is doubled and the motor, *E*, attains its full speed. This is the position of the switch as shown in the diagram. It will be seen that as the controller has only to regulate the field current, it may be a very small size and yet have a very large number of contacts, thus affording a very gradual control and securing absence of that destructive sparking of the contacts which is so common with rheostats carrying large currents. Further, the space occupied by this controller is but a small fraction of that required by the rheostats used on the series control system.

The loss in the motor-generator as ascertained by Messrs. Edward Lloyd, Limited, from actual records is small, while the loss in the controller varies from zero at half speed up to the maximum of only 2 per cent. at slow speed, or at full speed. The machine can be reversed if desired, but in the case of the Hoe presses it is only necessary that this reversal should be applied at low speeds. For this purpose it is provided that the motor-generator is capable of giving a voltage slightly in excess of that of the line, so that when it is in opposition to the line this excess causes a flow of current through the armature, *E*, which then rotates in a reverse direction.

The accompanying diagram as well as the illustration, Fig. 1, shows the switchboard and connections for this system of control for operating the presses. The numbers 1, 2 and 3 represent the single-pole switch, the slow-speed creeping switches and the field-reversing and regulating switches. The booster is noted at 7, and the motor for driving it at 10, while at 14 may be seen the starting switch for the motor. The motor, 5, is used for driving the machinery, 6 being its field coils. The single-pole circuit-breaker, 13, and emergency tripping coil, 12, as well as the double-pole circuit-breaker, 16, may be noted also on the switchboard, Fig. 6, as well as the meter at the right.

The switchboard is of enamelled slate, mounted with a motor-starter for the motor-generator, an ammeter having a two-way switch, by which means the current supplied to the press motor, or the total current taken from the supply mains, respectively, can be measured; and a voltmeter with a two-way key, which permits the voltage at which the press motor is working, or the voltage of the mains, to be read. Circuit-breakers take the place of switches and fuses, so that should an excess of current due to a jam in the press open the circuit, it can be quickly closed again when required, thus saving the loss of time due to replacing the ordinary fuse, an important consideration in the production of a paper.

The energy used is metered by a watt-hour meter, which not only integrates the energy by the usual dial, but also registers the rate at which it is used on a chart.

The flexibility of this system is well illustrated in the three creeping switches, which are placed round the machine at different points. These switches have 7 or 8 steps in parallel with the early steps of the controller, so that the machine tenders may themselves operate the press at the low speeds required for fixing the plates and threading the paper before the actual process of printing begins.

The whole regulation of the speed and direction of rotation is effected by the small controller; there is only one small hand wheel to work, which effects the whole of the operations in sequence, so that it is impossible, even for an expert attendant to make any mistake. The controller is carried on a pedestal which is fixed on the floor near the machine in the most convenient place. The main switchboard which carries the measuring instruments, etc., is fixed on the wall some distance off, out of the way, for it is not necessary for the attendants to use this board in operating the machine. As there is no large rheostat, the heating of the coils thereof is avoided and the plant will run for long and indefinite periods even at the very slowest speeds, while the wear and tear of the coils in the rheostat and contacts are obviated.

It may be of interest to add the following description of the signalling apparatus and switchboard arrangements, which, however, do not form a necessary part of the motor system. In order to signal to the attendant who operates the controller, a bell and indicator having three different colored lights are fixed near the controller, which are operated by pushes fixed at various points round the machine. The colors represent "start," "full speed" and "stop," while the

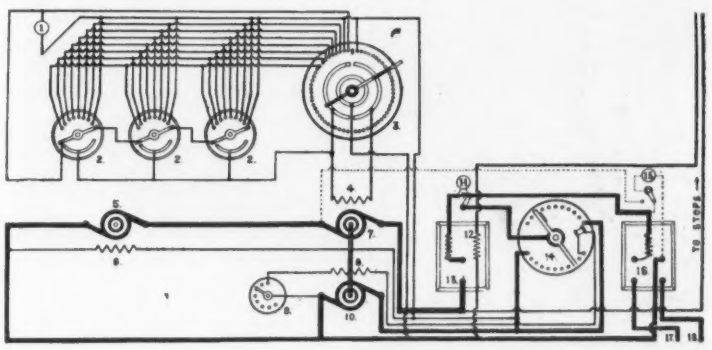


FIG. 4.—CONNECTIONS OF ELECTRICAL EQUIPMENT.

bell calls attention to a change in the signals. The color of the light remains constant until another signal is sent.

In case it is necessary in an emergency to stop the machine instantly, a circuit-breaker is provided which is operated by pushes placed round the machine alongside the pushes for signalling, and the circuit may be automatically opened by pressing any one of these pushes, which instantly stops the machine.

British Direct-Current Motors.

The accompanying illustrations show a type of direct-current motor made by the British Thomson-Houston Company. The sizes in which these motors are manufactured are ¼ to 15 hp for slow-speed, and 2 hp to 20 hp for moderate speed. Standard windings have been developed for the nominal voltages of 115, 200, 230, 400 and 500, but the motors can be used on circuits differing considerably from these nominal voltages.

The motor frame, which is also the magnet yoke, is of cast iron, and in the smaller sizes is rectangular in shape with rounded corners, in the larger sizes the circular form being adopted. At the commutator end the frame is provided with a projecting shell which protects the brush gear, while at the same time it allows ample space for it. In the sizes above 5 hp, the frame is divided horizontally, so that the upper half may be easily raised to facilitate inspection or removal of the armature. The armature may also be removed by taking off the pulley and shield, as in the smaller sizes. Ventilation is provided by hand holes, both at pulley and commutator ends, the latter being large enough to permit ready access to the brush-holders.

The pole pieces are made of sheet iron laminations, so as to reduce eddy current losses to a minimum, and are so supported that they can be readily removed from the frame. The field coils are held in place by the extended tips of the pole pieces. This construction allows the pole to cover a large portion of the armature surface without increasing the size of the field coil, and adds materially to the efficiency of the motor.

The bearings are carried by the cast-iron end shields, which are bolted to the frame. The end shields carrying the bearings may be rotated through angles of 90° or 180°, so that the motors may be easily adapted for bolting to a wall, or in an inverted position to a ceiling. The bearings are lubricated automatically by oil wells and revolving rings, and are provided with oil gauges. The linings are of solid gun metal in one piece.

The armature core is composed of sheet-iron laminations, assembled direct on the shaft. Each lamination is japanned, to prevent eddy currents, and air ducts are arranged for ventilating the core and winding. The laminations are clamped solidly between two cast-iron spiders. The "cylindrical" armature winding is employed. The armature coils are made of copper wire wound on a form, and are embedded in slots punched in the armature discs, and extend over the end flanges. The cylindrical winding provides large radiating surface for the armature conductors, reduces the length of wire, and consequently the loss due to resistance. It therefore conduces to cool running and high efficiency. The separately-formed coils, of which the winding is composed, are easy to remove and replace.

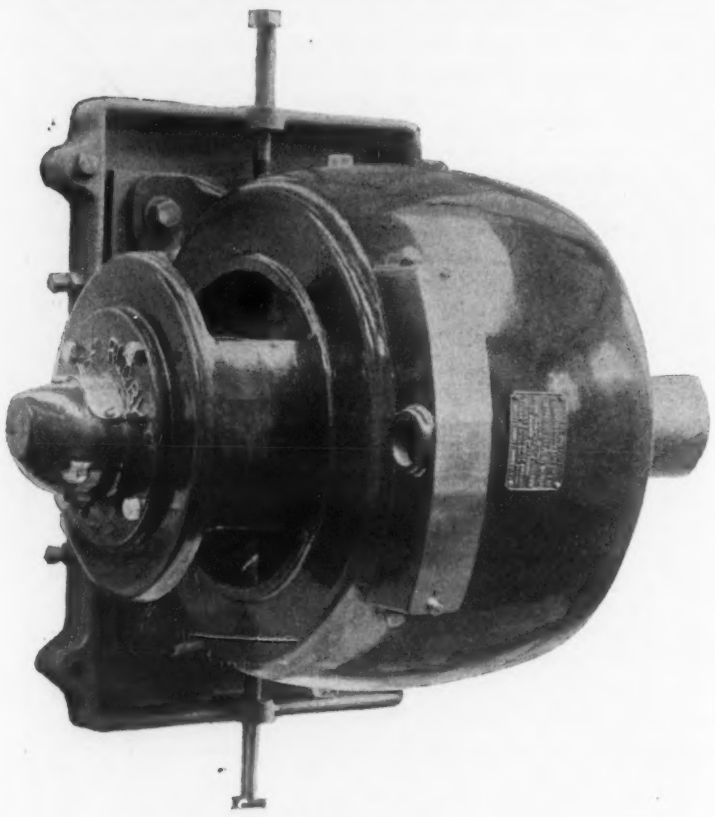


FIG. 1.—MOTOR ON WALL.

The brush-holders are arranged for carbon brushes, which slide in finished ways, and are pressed against the commutator by independent pressure fingers, an adjustable spring in the rear of the holder enabling the pressure to be regulated throughout the whole life of the brush.

The standard motors are shunt-wound, but series-wound motors can be supplied for use on cranes, winches, etc., where a variation of speed with load is required, while for printing presses and other machines requiring large torque at starting, compound-wound motors are recommended.

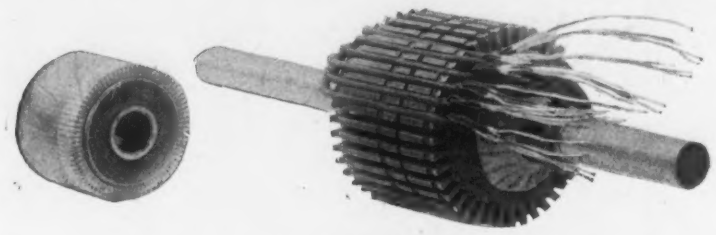


FIG. 2.—ARMATURE.

The motors operate practically without sparking at the commutator, and changes from no-load to full load require no shifting of the brushes. The partially enclosed motors run with full load at an unusually low temperature. After running for 10 hours at their rated load and voltage, the rise in temperature above that of the surrounding air will not exceed 40° C., as measured by thermometer on any part of the motor. They will run for one hour under a 25 per cent. overload, and will stand a momentary overload of 40 per cent. without injurious heating, or sparking at the brushes.

Large S. K. C. Transformers.

The large transformers herewith described are built by the Stanley Electric Manufacturing Company, which, from its inception, has devoted special study to the perfection of transformer design. These transformers are installed in many locations, particularly in transmission systems operating at unusually high voltages, such as those on the Pacific coast, and are used to a considerable extent by interurban roads throughout the country.

Fig. 1 shows very clearly the construction of the S. K. C. oil-insulated, water-cooled transformer. The windings, both primary and secondary, are subdivided into from four to eight separate coils, each coil being wound in a number of layers, thus permitting the voltage between layers and across the terminals of any one coil to be kept low, and allowing each individual coil to be thoroughly insulated both internally and externally before assembling. In the smaller transformers, the coils are placed on both legs of the iron as in Fig. 3, and the design is known as the "Core Type." Those wound for 30,000 volts and higher and of 200-kw capacity and larger have the iron built on both legs of the coil, forming a complete shell around the coil, from which the design is called the "Shell Type." This style of construction is shown in Figs. 1 and 2. In both designs the coils are placed side by side, a secondary coil between any two primary coils, and are insulated from each other and from the iron by sheets of insulating material, liberal space being left so that the oil can circulate freely around the various coils and between the coils and iron.

A particular feature of S. K. C. transformers is that the casing is of heavy boiler plate, which cannot be broken or torn or punctured so as to release the oil and allow it to flow out, as not infrequently happens to transformers with sheet iron casings. The boiler plate is riveted to the cast-iron base and then thoroughly calked. The mass of coils and iron is also rigidly fastened to the base and is not in any way supported by the casting, this robust style of construction being shown in Fig. 1. Heavy eye-bolts with turn buckles pass through the base and cover, making a most secure and substantial combination, and one in which strains due to shipping and lifting cannot cause leaks.

The spiral through which the cooling water passes is made of brass, which is preferable to iron because it does not corrode even

when salt water is used. Being of thinner gauge and higher conductivity than iron it conducts heat with greater facility, therefore dissipating a given heat with the consumption of less water.

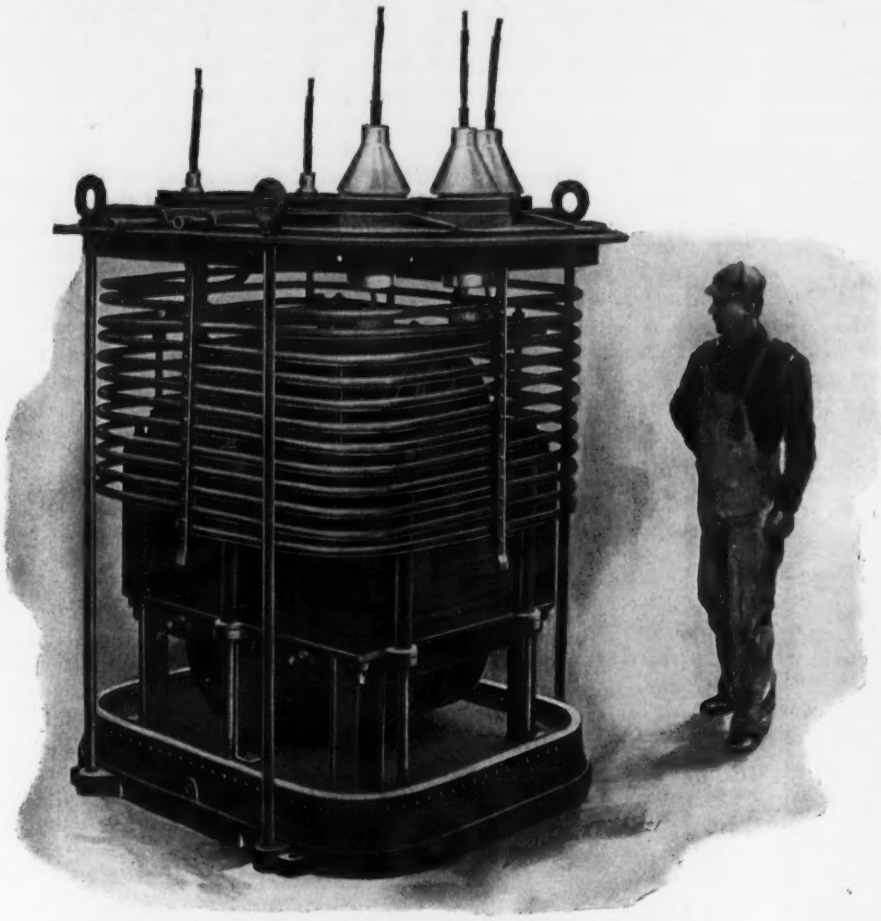


FIG. 1.—800-KW TRANSFORMER WITHOUT CASING.

The coils and core can be removed from the tank without disturbing the spiral coil and its connections. All the interconnections between the coils are made at the top so as to be readily accessible. The main primary and secondary leads are brought up to the terminal boards, rigidly supported above the coils, the primary board being on one side and the secondary on the other. From these boards the leads are brought out through porcelain insulators of unusually liberal proportions. Type W transformers will stand large overloads for a reasonable time, the supply of water being proportionately increased. They will also carry full load for from three to six hours without the use of water and without a dangerous rise in temperature. They are wound for voltages up to 60,000 and are made in capacities up to 2,000 kilowatts.

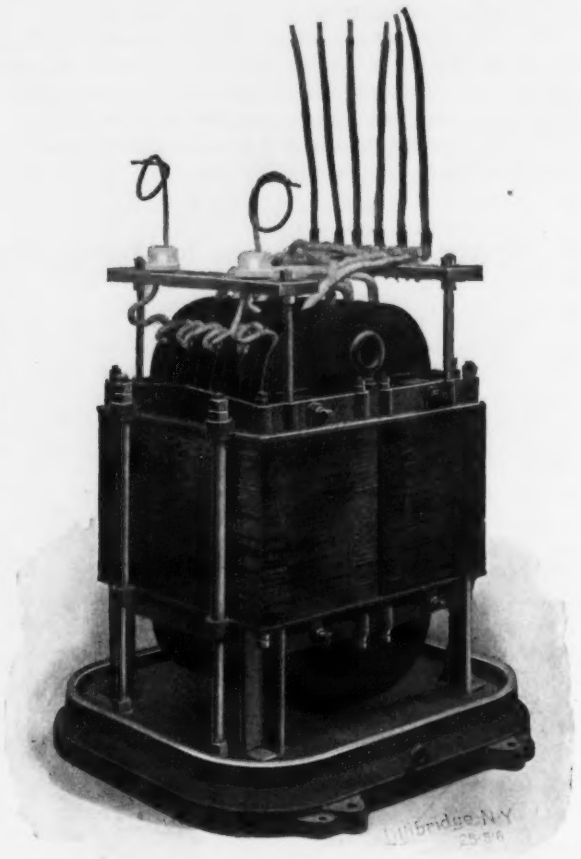


FIG. 2.—500-KW TRANSFORMER COIL AND CORE BUILT UP.

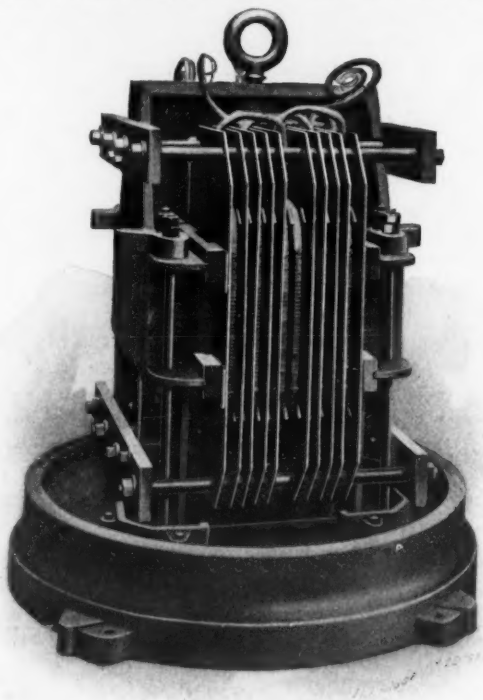


FIG. 3.—40-KW TRANSFORMER WOUND FOR 40,000 VOLTS.

FIG. 4.—110-KW, 25-CYCLE TRANSFORMER.

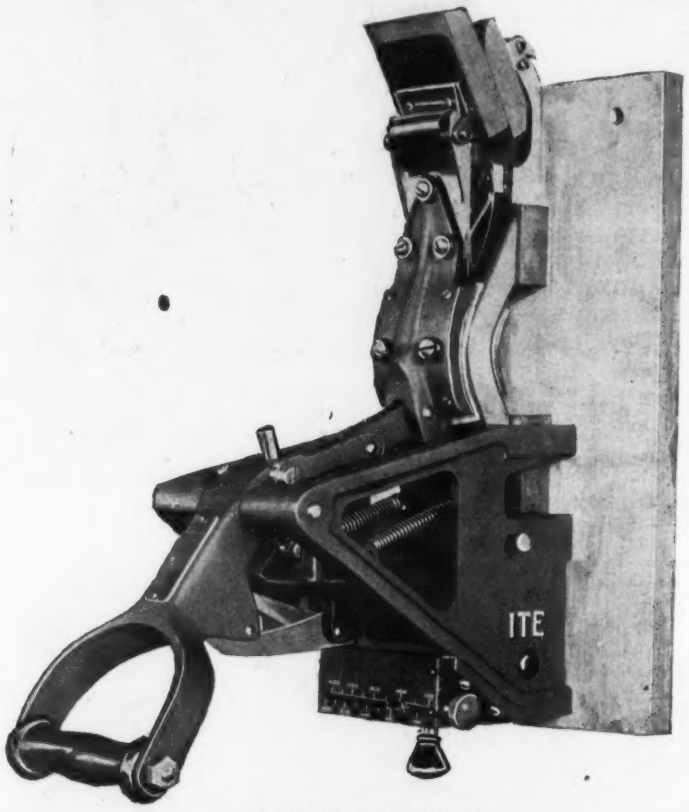
The S. K. C. type of oil-insulated, self-cooled transformers shown in Fig. 4, are built along the same general lines as the other type excepting, of course, that they depend upon their large radiating

and convective surface and the natural circulation of the insulating oil for the dissipation of the heat caused by the iron and copper losses. As will be observed from the illustration, remarkably large surface is provided by strips of iron fastened on edge around the outer surface of the tank or case.

Type T transformers are wound for voltages up to 35,000 and are made of from 10 to 500-kw capacity. Type T transformers are intended for continuous heavy duty and have a high efficiency, close regulation and low heating and are suitable for use in all places where the smaller sizes of this type would be used, but where water is not available for cooling purposes.

Special Circuit Breakers for Testing Purposes.

With the development constantly going on in the electrical art, circuit-breakers have come to play an important part. One pressing condition has recently been brought to bear upon circuit-breaker engineers with peculiar force, and the Cutter Company responded with instruments having a range of adjustment greatly in excess of the figures which were once deemed inadequate. Frequently this



A TESTING CIRCUIT-BREAKER.

call comes from professors of electricity and engineering in the large technical schools. The use of circuit-breakers in such institutions becomes daily more imperative, and it is of importance that the instruments upon which they rely in class and laboratory work be up-to-date. More frequently, however, the inquiry comes from the engineer in charge of the electrical equipment of a manufacturing plant, with enlargements, in view; and while suitable protection must be provided for the smaller units at first employed, the protective devices are required to have sufficient capacity and range which will admit of their use after the extension of the plant. In the testing laboratories of generator and motor manufacturers also, with whom it has become the universal practice to test each unit at its full load, and upon stated overloads, circuit-breakers are employed upon the testing circuits in order that the assigned conditions of test may not be exceeded. Where units of greatly varied capacities are tested, the number of breakers required may be minimized by the employment of types with the widest possible range and relatively high current-carrying capacity.

The illustration shown herewith was made from a circuit-breaker recently built for the testing laboratory of a large manufacturing establishment. It has a normal rating of 1,000 amp, which it will carry continuously without heating over 20° C. While somewhat similar in construction to the standard apparatus, the solenoidal magnet has been replaced by a peculiar form of horseshoe magnet, concealed beneath the housing. By this construction a special range of adjustment is attained, namely, from 150 to 1,500 amp, and it operates satisfactorily for any voltage of 750 or less. The tripping mechanism is so designed that the restraining latch is acted upon with great positiveness at all points within its especially wide range. The adjustment is readily effected, as will be seen by referring to the illustration, and is constant throughout. The calibration scale being nearly four inches long, the divisions are of ample size for convenient reading. It will be noticed that the scale is horizontal instead of vertical (as is usual), and is upon the front of the circuit-breaker, where it may be conveniently read from a distance. The same form of construction has been applied to instruments of larger capacities, where even greater proportionate ranges may be secured.

Cosmo Railway System.

An operative model of the Cosmo railway system has been on exhibition at 307 Fifth Avenue, New York, where it has been inspected by many railway men. The system is notable for its comprehensiveness, and the many functions which it performs would seem to provide for every contingency in the safe operation of a railway.

The system is designed particularly for use in steam railway yards and elevated and tunnel electric roads, and embraces many interesting and novel features. It includes two methods of moving trains, i. e., by the third-rail system and by the overhead contact system. In connection with either one there is an automatic block signal system, a multiple-unit system of control, magnetic brakes and a despatcher's selective control system.

On page 698 of our issue of April 19, 1902, was given a brief description of the overhead and signal systems, which were then on exhibition in New York. Other features have since been added with a view to making the system more comprehensive and meeting the more exacting requirements of practical work, particularly on suburban lines, whether on the surface, underground or overhead. The overhead and signal systems have not been materially changed since the time of the earlier exhibition, therefore the description of them will apply in the present case, without repetition.

In the third-rail system the current for the operation of the automatic signal apparatus is derived from the third rail through an auxiliary contact, thus obviating the necessity of carrying storage batteries on the cars, or locomotive. The signals and the method of their operation are precisely the same as described in the former article, and indicate to the engineer, or motorman, as the case may be, the nature of an obstruction ahead, whether it be a broken rail, an open bridge or a train on the same block.

One of the most interesting features of the system is the despatcher's selective system of controlling cars or trains out on the line. It provides means for communicating with any office on the line telegraphically by selection, and stopping a car anywhere on the road by simply cutting off its supply of current by means of the same selective apparatus. Each telegraph office is equipped with a recording register similar to a stock ticker, upon which any communication to the agent or operator may be recorded, whether the attendant is present or not. Since the instrument operates only when it is selected by the despatcher, it is not in circuit at other times. The system is, therefore, a secret one, and no office can get a despatch not intended for it. The entire line is under the control of the despatcher at all times. If one office desires to communicate with another the despatcher, upon receiving proper request, makes the necessary connections by simply inserting a plug in the proper hole in the selective keyboard.

In case the despatcher wishes to stop a train at a station that would otherwise be passed without a stop, he puts a plug in the proper opening which in effect cuts off the traction current supply at the station. After this is done and the train is brought to a halt orders for the train crew are transmitted as above.

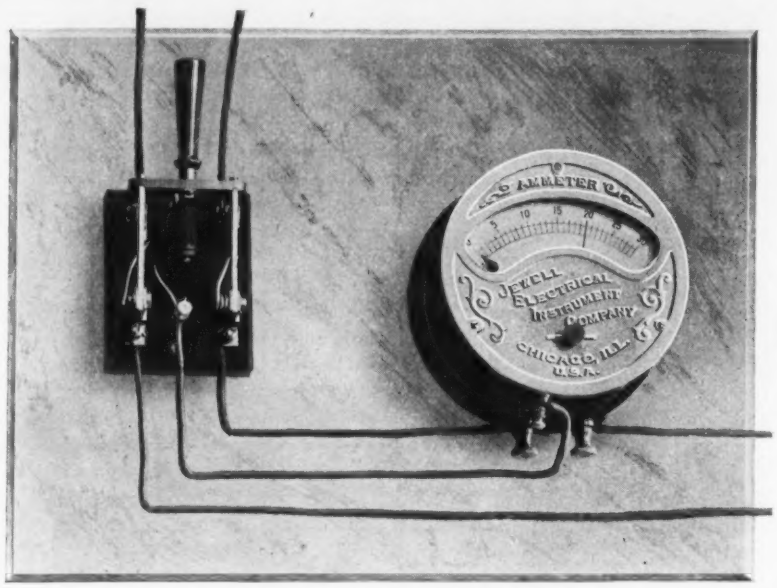
In the operation of the model the two trains, with which it is equipped to represent actual working conditions, were under perfect control at any point along the line, and to further represent an actual road, crossings, switches, etc., were also provided. The readiness and ease with which the rear train was brought to a standstill when the block ahead was not entirely clear, and then started up again when it became clear, give one the impression that collisions

are entirely avoidable. The model is 41 ft. long and 14 ft. wide and every part is made to scale.

Mr. Robert J. Sheehy, the inventor of the system, will sail shortly for England, where, he states, the system is to be installed on an English road. He will take the model with him and exhibit it in practical operation for the benefit of English railway men.

Jewell Circuit Breaking Ammeters and Voltmeters.

An interesting and useful combination of circuit-breaker and ammeter has been made by the Jewell Electrical Instrument Company. This combination, for circuits of small capacity, is illustrated herewith. The ammeter is one of the Jewell "baby" type of instrument and is provided with contacts, so that when the needle of the instrument swings above the point for which the circuit-breaker is set, a circuit is closed which energizes a magnet and trips a double-pole switch in the main circuit. For larger circuits, the regular circuit-breaker with carbon breaks can be used in connection with the instrument. The contact arm of the instrument is set at any desired point on the scale by revolving a milled head on the front of the instrument. It will be evident that this device can be used as an underload as well as an overload circuit-breaker, by providing two contact arms instead of one, one of these always remaining below and the other above the index needle. The same device applied to a voltmeter can be arranged so that an excess of voltage or an absence of voltage will open the switch.



CIRCUIT-BREAKING AMMETER.

An application of these instruments which at once suggests itself is that of automatically opening the charging circuit through a storage battery. The charging circuit can be opened either by the underload contact of the ammeter, thus cutting out the cells when the current falls to the minimum desired, or by the over-voltage contact of the voltmeter opening the switch when the voltage of the cells reaches the maximum, thus preventing the overcharge of the batteries.

It is said that a circuit-breaking instrument of this kind affords a much more accurate and sure method of opening the circuit at any predetermined point than the circuit-breaker coil on an ordinary circuit-breaker, which has to work against a certain amount of friction which is uncertain in quantity.

Where tools are driven by electric motors, they are often worked in excess of the rated capacity for some time, simply because of the ignorance of the operator of the machine as to what current is being taken. If the operator has a reliable instrument indicating at all times the power he is using, together with a circuit-breaker which stops the motor in case too much is used, there is almost absolute protection against burning out of the motor by overload. These circuit-breaking ammeters and voltmeters are made by the Jewell Electrical Instrument Company, of Chicago.

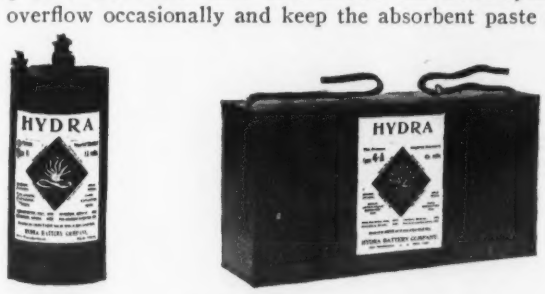
Power Transmission at Clermont-Ferrand, France.

An interesting hydroelectric plant is now being installed by the Gas Company of Clermont-Ferrand, to reinforce their existing electrical plant. The new works are situated on either side of the River Sioule, below the dam, which will be 30 m in height with a maximum width of 25 m, forming a lake about 6 km long, with an average breadth of 120 m and a surface of 100 hectares. Independent pipe lines fixed in masonry will supply each turbine, the turbines will be six in number, of 1,000 hp each, of the horizontal axle "Francis" type. They are made for a head of 20 to 25 m, with a minimum quantity of water 6 c m per second. At such times as after a heavy thaw, the river can supply as much as 500 c m per second. Each turbine will be connected to a three-phase alternator of 800 kw at 1,000 volts, 50 periods and 333 r.p.m. The two exciters of 37.5 kw each are driven by small auxiliary turbines. The voltage will be stepped up to 20,000 by means of Westinghouse monophase transformers, grouped in threes.

The overhead transmission line will be double, and about 45 km in length. Poles and cross beams will be of wood, the latter being boiled in paraffin and then covered with a layer of tar. The setting up of the line, as well as the construction of the electrical and mechanical apparatus, has been undertaken by the Société Anonyme Westinghouse, of Havre. The hydraulic part of the work has been hurried forward during the last year and is now well advanced, while the mechanical and electrical equipment is just finished. Power will be sold at Clermont-Ferrand, which is a great center for the rubber trade, for both lighting and power, and considerable development of the existing works will be expected with the advent of a power so simple and so cheap as electricity.

Improved Dry Batteries.

A variety of types of their dry battery and of apparatus applying it have been put on the market by the Hydra Battery Company, of 70-72 Reade Street, New York city, two types of whose cells are herewith shown. This semi-dry form of battery was introduced from Germany, where it was perfected by Prof. P. Schmidt, C. Koenig and R. Krayn. The cell comprises a cylinder of zinc closed at the bottom end and open at the top, holding in its interior a special liquid electrolyte, and connected by an insulated wire to the outer thick zinc cylinder. The zinc cylinder is placed within the carbon cup with an absorbent paste depolarizer between the two surfaces, the cup having a terminal at its upper end and its lower open end sealed up with pitch. Outside the carbon cylinder is a dry-pressed generating depolarizer inclosed in a network of linen, which is encircled by the outer zinc from which the other terminal rises to the top of the cell. Over all the elements at the top is saw-dust and absorbent cotton, and from this rise vent tubes which pass through the asphalt top. The whole is enclosed in a thin outer metal or wood casing insulated from the outer zinc cylinder by which the battery is protected from dampness and other injury. A small chamber in the carbon cylinder at the top just above the inner zinc allows the electrolyte in the latter to overflow occasionally and keep the absorbent paste slightly moistened. The moisture thus absorbed passes through the porous carbon to the dry absorbent, thereby maintaining it in proper condition for the generation of a current when the terminals of the battery are connected. The perfectly dry condition of the generating depolarizer prevents any local internal action when the cell is not in use. The double surface of zinc provided by having an inner and outer zinc cylinder as well as the depolarizing material on the inner and outer side of the carbon cylinder, give the battery a remarkably constant voltage, low internal resistance and high capacity,



DRY BATTERIES.

with the added advantage that the moist electrolyte is brought to the relief of the decomposing paste, keeping it permanently humid, giving the cell excellent power of recuperation after long use.

These batteries are already coming into large application in this country, and abroad have, it is said, been adopted by five European governments. The literature of the company includes in its descriptions not only various forms of cell, but special groupings for automobiles, spark coils, etc.

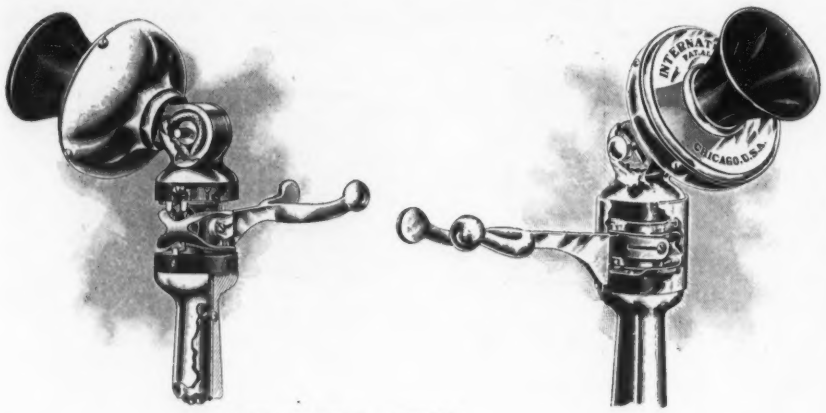
New "International" Telephones.

A variety of new and ingenious apparatus has just been placed upon the market by the International Telephone Manufacturing Company, of Chicago. The portable telephone, as a rule, having more hard usage and careless handling than any other instrument in a telephone system, is most subject to becoming out of order. The International desk telephone (shown in Fig. 1) was designed with

FIG. 1.—DESK SET.

a view of securing a neat-appearing, convenient and reliable and durable instrument. The pedestal is an artistically-designed stand of heavily nickel-plated cast brass. It is hollow, to allow the transmitter cords to pass through it. The standard and bottom are clamped firmly together with a heavy binding nut in the base. All exposed parts of the instrument are strong, smooth and solid, and are made of nickel-plated brass.

The entire switch in the desk set is built in the spring post or head of the pedestal (as shown in Figs. 2 and 3). The spring post can be readily removed from the pedestal and all parts conveniently inspected. The switch and restoring springs are mounted on hard rubber blocks, supported by the spring post and are completely enclosed with a dust-proof cover. The contact springs are all long and are made from the best German silver, and are provided with



FIGS. 2 AND 3.—DETAILS.

platinum contacts. The hook is provided with an insulated pin near its base, to which the restoring spring is connected. This insulated pin is provided at both ends with platinum contacts, which make and break the connection when the hook is raised and lowered. This connection gives a switch in which the platinum contacts make a clean, positive sliding connection and require but a very small movement of the springs.

The hook restoring spring is so designed that it has three inches of heavy spring German silver for a restorer, making the switch very active and durable. The springs are firmly clamped with heavy, specially stamped nuts, fastened with machine binding screws passing through the rubber block from the opposite side. All binding screws are threaded into metal, leaving no binding screws depending on threaded rubber. The hook takes its bearing in the spring post on special steel screws. These screws are not pivot screws, but extend into the post and form a bearing fully 3-16 of an inch in length. The back of the hook, where the steel bearing screws enter, is slotted and is firmly clamped to the screws to prevent any possibility of the bearing working out or becoming loosened. The hook stops directly on a heavy brass screw that is shouldered against the brass spring post to make an absolute and positive stop and avoid any liability of weakening or breaking the lower contact spring.

The movable head or lug is provided with a concealed stop of the same design as in the knuckle-joint. All springs and connecting wires are entirely enclosed and perfectly insulated, positively leaving no exposed metal parts to form a part of the circuit at any time. All exterior or visible parts are of heavy, smooth brass and are nickel-plated and highly polished.

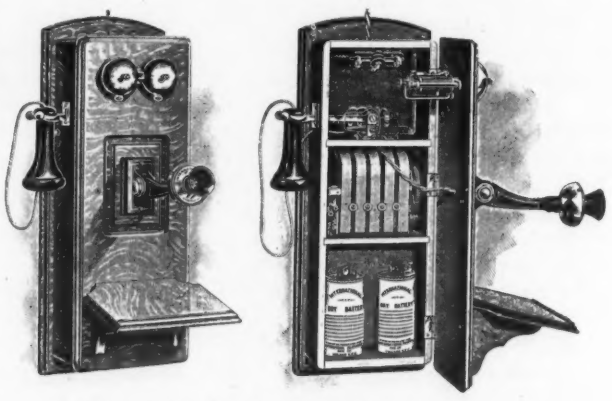
The International generator-call wall telephones are especially designed for rural village exchanges and heavily loaded country party lines where any and all small trouble in a telephone system is very annoying and invariably costs seriously for removal. The type shown in Fig. 4 is neatly designed, compact and strongly built. Fig. 5 shows the instrument open. The lightning arrester, line terminals and ground post are mounted inside at the top of the box. The arrester is of original design and strongly built. The insulated line wires pass directly into the magneto box and terminate at the line posts inside, leaving no room for the wires to become accidentally disconnected or for any foreign material to get into the arrester, short-circuiting the instrument and throwing it out of adjustment.

The hook-switch is of the long lever, gravity type and is provided with a five-inch restoring spring. The switch has no rubbing or scraping parts excepting at the contact points, which form a positive sliding connection. The springs are all insulated with hard rubber and mica, and the hook forms no part of the circuit.

The ringers of the series and bridging instruments are all of the long frame type, allowing change of the ringers from series to bridging by changing the windings on the coils only. This also makes all parts of the various instruments in an exchange uniform throughout. The bell hammer is protected by a nickel-plated guard.

The generator armature cores are laminated and the cores thoroughly insulated with specially prepared linen and wound with silk-covered wire. The pole pieces are of extra soft malleable iron, and the bearings are heavy brass castings and are provided with oil cups. The permanent magnets are evenly bent from heavy bars of the highest grade of magnet steel and strongly magnetized.

The main gear is as wide as practicable and has a wide face, evenly cut, to insure its running smoothly and practically without noise. The small gear is of hard steel to give it wearing qualities equal to



FIGS. 4 AND 5.—WALL TELEPHONE.

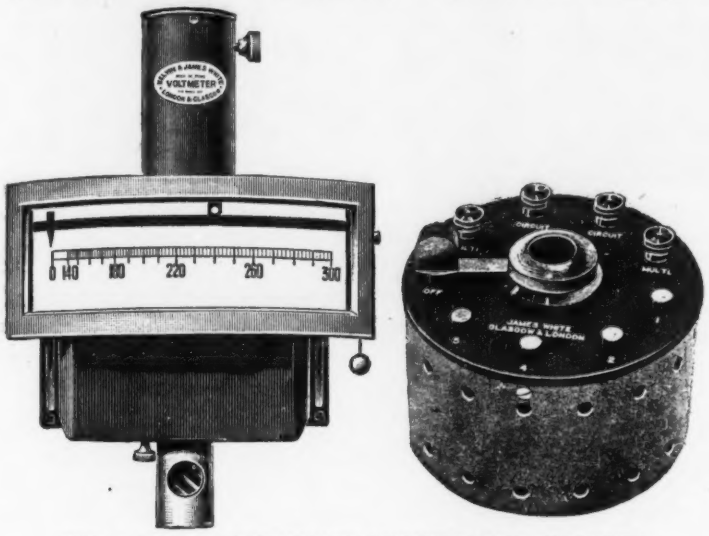
the large gear. This gear is provided with a spring and is flexibly attached to the armature shaft so that the armature cuts the fields quickly without any jerking when turning the generator. The ends of the armature are provided with a fibrous guard to prevent oil or other foreign material getting into the armature winding. The

generator is equipped with a positive shunt, which is provided with a spring, short-circuiting the armature when in its normal position, to avoid burn-outs from lightning or other heavy electrical currents. It is also provided with heavy terminals, mounted so that connections may be conveniently made.

All the International telephones are equipped with the company's regular double-pole adjustable horseshoe magnet receiver and long-distance adjustable transmitter, both of which are well known in the telephone field for the high-class work in their construction and their clear and distinct working. Their form of construction leaves absolutely no connecting wires, terminal screws or binding posts or any metal parts to form any part of the circuits exposed.

Kelvin Electrostatic Voltmeters.

An improved switchboard type of the Kelvin multicellular electrostatic voltmeter has lately been put on the market by Messrs. Kelvin & James White, Limited, of Glasgow, Scotland. It has been thought by some engineers that these instruments are too delicately constructed for ordinary switchboard use, but there is hardly a



FIGS. 1 AND 2.—ELECTROSTATIC VOLTMETER AND MULTIPLIER.

central station in Great Britain which has not one or more instruments of this class fitted on the board, and experience has shown that there is far less trouble through breakage with this class of instrument than with others in use. The only objection to the more universal use of this instrument has been the shortness of the scale obtained, but in the improved form this difficulty has been overcome, a scale of 6 in. and even 10 in. being used. The 6-in. instrument is approximately the same size as the older pattern, and this increased scale has been obtained without in any way increasing the distance which the instrument projects from the board. The method of supporting the instrument has also been improved, Lord Kelvin's well-known method of the hole, slot and plane being used so that the instrument can be quickly and accurately leveled.

Fig. 1 shows the 6-in. switchboard form of instrument having a range of 140 to 300 volts, but any range from 80 to 1,400 can be obtained on this particular form. For higher ranges where the full pressure is connected directly to the instrument, another type is used, but the form illustrated can of course be employed with a potential transformer.

The accuracy guaranteed for these instruments is ⅓ of 1 per cent., which is sufficiently good for switchboard work. A valuable adjunct to these instruments is a multiplier lately put on the market by the same firm. This multiplier enables any desired range to be obtained on one instrument, but the standard multiplier (Fig. 2) gives four ranges from 30 to 600 volts.

Steam Distribution From Central Stations.

The American District Steam Company, of Lockport, N. Y., originator and patentee of underground system of steam distribution, has built over 250 steam-heating plants in different cities in the country. It reports that during the past year it has installed over thirty-five new underground steam-heating plants, besides making extensive additions to ones previously built. The majority of these have been built for electric current supply companies for the utilization of the exhaust steam for heating purposes.

The subject of exhaust steam heating appeals especially to electric and power companies, which regard their exhaust steam as a wasted by-product, or one from which they get small compensation by the use of condensers. It is the impression of some that exhaust steam is saturated with moisture and that it does not contain an equal number of units of heat as compared with live steam. This is a fallacy. Steam of equal pressure has equal temperature. It is demonstrated from actual experience that the exhaust steam from each 100 hp of engines operated, will heat from 1,000,000 to 1,300,000 ft. of space in average buildings, in zero weather.

Electric companies operating exhaust steam heating report that the receipts of the sale of steam are enough to pay all their fuel and labor bills for the entire year, and interest on the investment for the steam mains. The great advantage of district steam heating over any other system is that buildings already piped for steam, or hot water heating, and having their own boilers, can be connected with the steam mains without any change in the piping of the building.

The American District Steam Company also manufactures a meter for use in recording the amount of steam used in each building, which is very accurate and inexpensive, and is being used very generally by companies operating a district system of steam distribution.

During the past year the business of the company has grown so rapidly that it was necessary for it to double the capacity of the works both in Lockport and North Tonawanda, N. Y. The company is just now engaged in installing exhaust steam-heating plants in Baltimore, Md.; Birmingham, Ala.; Paducah, Ky.; Rockford, Ill., and is shipping material for a large extension of steam mains to the plant installed by it at Atlanta, Ga., some two years ago. It is also making several other extensions in other cities.

Iron Box Telephones.

We illustrate herewith a telephone specially designed for street railway work. It consists of a very heavy iron box containing a complete telephone with a very powerful signaling equipment. These instruments are made weather-proof and practically damage-proof. When the door is closed it engages with the pin marked *A* in the cut and disconnects the entire apparatus from both sides of the

IRON BOX TELEPHONE.

line. This not only prevents "burn-outs" from lightning and crossing of line wires, but allows of an infinite number of stations being put on one pair of wires, as only the station in use is connected across the line at any time. The hand micro-telephone, combining both receiver and transmitter, has been found to be peculiarly well adapted for this particular work. It allows of the box being supported a good distance from the ground and yet it can be used by

either short or tall people with equal convenience, while as the construction compels the person using it to speak directly into the mouthpiece good transmission is assured.

This particular style of box is being installed by a large number of the prominent trolley roads on the turn-outs, and is said to be very satisfactory. It is manufactured by the Couch & Seeley Company, Boston, Mass., who also make other forms of telephones with an iron housing, suitable for mines or other places where it is necessary to locate a telephone amidst damp and dusty surroundings.

Electric Hoists for Docks and Wharves.

Electric motors are fast displacing steam engines and shafting on account of their economy in operation, and nowhere is this saving more apparent than in intermittent hoisting work such as that in handling freight at docks and wharves. With electric hoists there is no loss due to condensation in long steam pipes, which loss frequently amounts to 25 per cent. of the power used, and there are no pipe lines with joints to be kept tight as with steam engines. With shafting the loss in transmission of power due to the friction at the bearings is very high. At one steamship dock in New York City, it was estimated that it took three tons of coal per day to run the shafting alone. This loss is practically eliminated with electric power.

An electric hoist may be stationary on the wharf where a great deal of work is to be done, or its base carried on wheels, or it can rest on a small wagon. If the hoisting is to be done along the face of a dock the hoist may be mounted on a narrow-gauge railway car, the track for which extends the length of the dock. For supplying power to portable hoists the electric mains are run to boxes stationed at intervals.

With a cable having a plug terminal which is inserted in the box, the hoist can be moved anywhere within the radius of the cable; beyond this the plug is inserted in another box. Such a hoist is shown by Fig. 1 and built by the C. W. Hunt Company, West New Brighton, Staten Island. A 500-volt street railway type of motor is employed for driving. Either direct or alternating-current motors of any commercial voltage may be used.

The three essential parts of the hoist are the rope drum, the gearing and the electric motor. These are made in a series of sizes, and by a suitable combination of each a hoist of any desired capacity and speed, within the limits of modern practice may be built.

There are four factors that materially affect the size and cost of the hoist, namely the load, the speed, the height to which the load is hoisted and the frequency of the trips. These factors affect the size, operation and cost in the following manner:

If the load is increased, the size, weight and strength of the

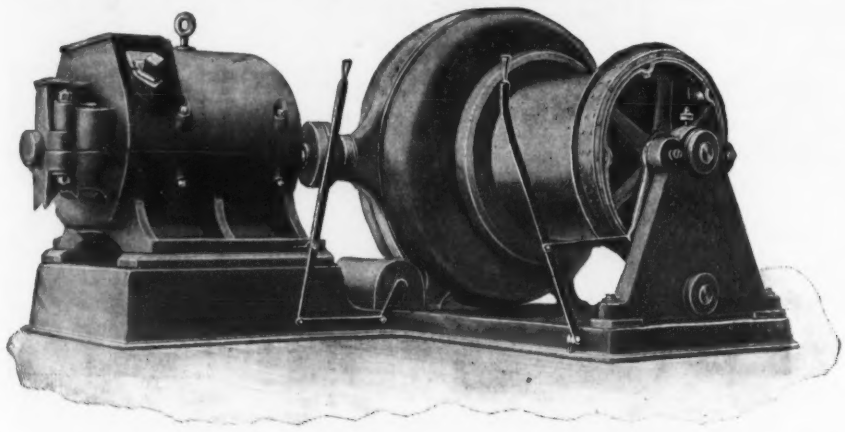


FIG. 1.—ELECTRIC HOIST.

mechanism will be increased; that is, a larger size must be used. If the velocity of hoisting is increased, the size and power of the motor will be increased, the other parts remaining the same. If the height to which the load is hoisted is increased, the drum must be increased to hold a longer rope, the motor remaining the same. If the frequency of the trips is increased, the size of the motor will be increased, the other parts remaining the same.

There are three methods of operating electric hoists: 1. Running the motor continuously, hoisting the load by throwing in a friction clutch and lowering by a band brake. This method is suitable either for alternating or direct-current motors. 2. Starting and stopping the motor for each lift, lowering by a band brake. This is better suited for direct current than alternating motors. 3. Running the motor forward to hoist and backward to lower. A direct-current motor, with reversing drum and switches is used for this work. The mechanism of the hoist is so arranged that any size or make of electric motor may be used. The motor is connected to the hoist by a flexible insulating coupling.

The great flexibility of electric transmission allows hoists to be installed to advantage in many situations where it is difficult or inexpedient to use steam-driven machinery. One of the great advantages is that the expense for power begins only when the hoist is started, and entirely ceases when the motor is stopped.

The illustrations show two types of electric hoists, built by the

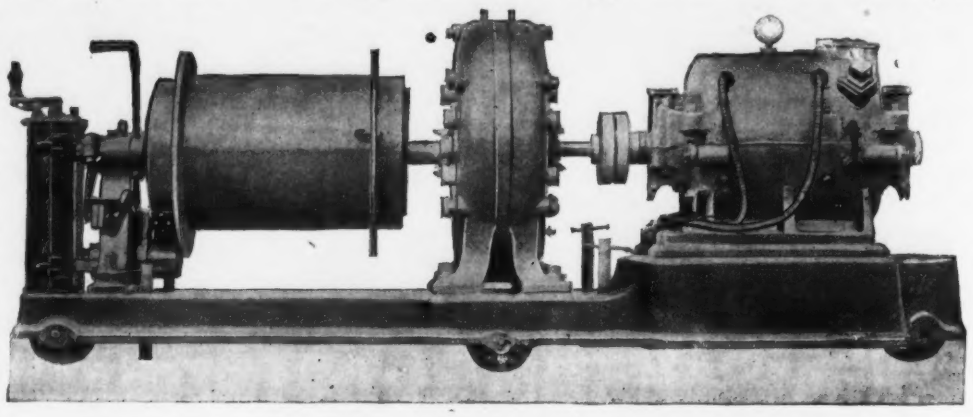
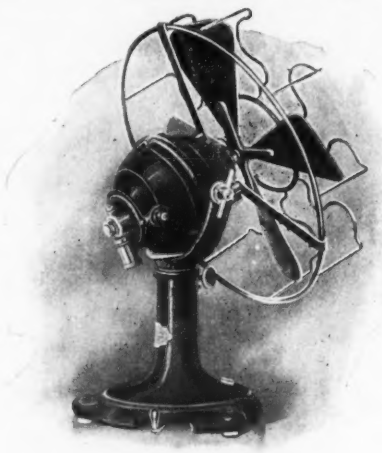


FIG. 2.—ELECTRIC HOIST.

C. W. Hunt Company for this particular class of work, and which possess the advantages enumerated above. The remarkable convenience of electric hoists for use on docks and wharves have been found an important element in their favor. They are always ready for service by simply switching on the electric current for driving the hoist. When loading or unloading is completed the switch is opened, and the operator can leave the machinery at once.

Lundell Fans for 1903.

The Sprague Electric Company has brought out its 1903 model of electric fan, as shown herewith, being along familiar and approved lines of construction. Lundell fans have always sold readily, and



ONE OF THE 1903 FANS.

given universal satisfaction because of economy in current consumption, great durability, quiet running and attractive appearance.

The motor is of the single field coil type, of great simplicity and compactness. A single coil energizes directly both pole pieces and the armature. The motor has a strong torque, which permits the

use of fan blades with considerable pitch, thus driving a large volume of air with a minimum amount of current.

The self-feeding oil cups invented by Mr. Lundell have proved so successful that to-day they are a standard feature in fan motor design.

The Sprague Electric Company has already received large orders for this season's supply.

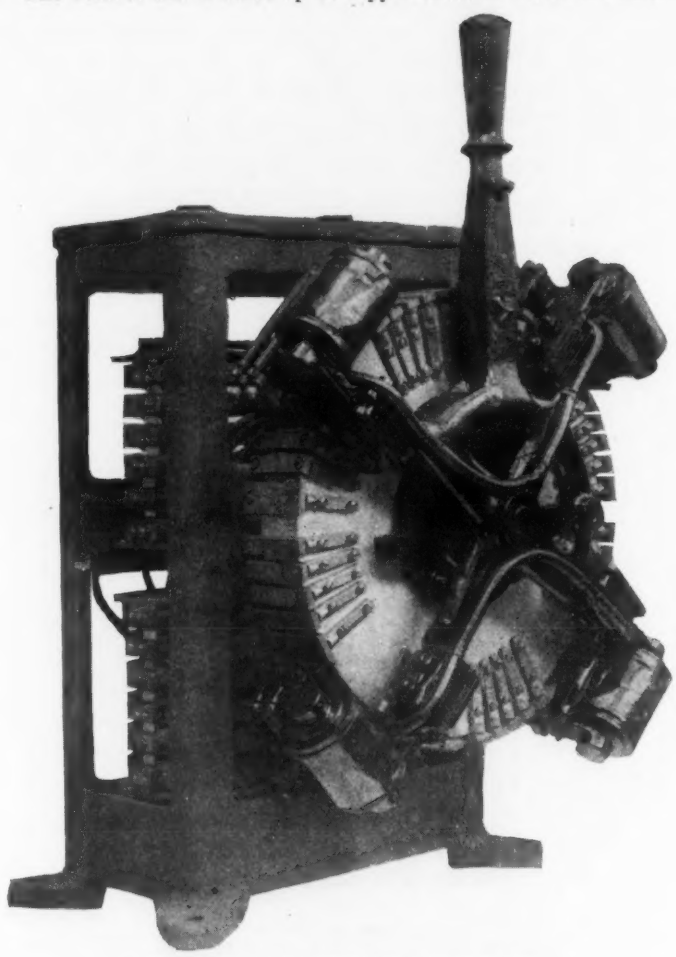
Regulating and Reversing Controller for Direct Current Motors.

For the control of direct-current motors operating cranes, hoists, etc., and similar appliances requiring variations in speed and frequent stops and reversals, the Westinghouse Electric & Manufacturing Company has placed upon the market an improved controller of the commutator type which has been designed especially for this class of work.

This controller is similar to the Westinghouse commutator type controller which has been in general use for some years, but embodies several changes and improvements. The necessary resistance is mounted inside of a cast-iron frame, on the outside of which is attached the commutator, or contact dial, for regulating the amount of resistance in circuit and for reversing the motor.

In the smaller sizes the resistance is of the ventilated cell type as shown in the cut. This construction is the same as that used in the Westinghouse standard railway controller resistance, a service where its efficiency and durability have been proved by years of the hardest usage. The resistance in the larger sizes consists of cast-iron grids of very durable construction. These grids are capable of withstanding very severe use, it being practically impossible to burn out or otherwise injure them. They are also the same as those used in railway service.

The contact dial is made up of copper contacts which are fastened



REGULATING AND REVERSING CONTROLLER.

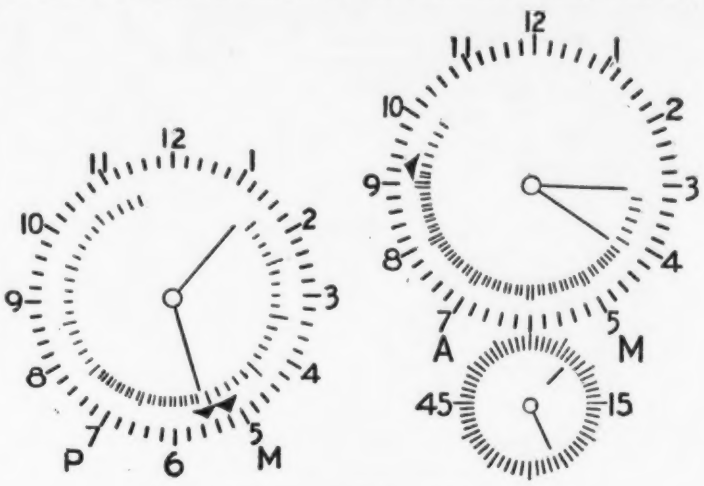
to the periphery of a circular stone of good mechanical strength and toughness, affording a firm support and giving excellent insulation for the parts. The contacts are simple and so made that they may be easily renewed when injured by wear or any possible arcing. Their total makes possible a correspondingly large number of steps of resistance, giving a very gradual regulation to the motor.

The brush-holder is fitted with four contact arms, which, when the circuit is opened, divide the arc into four breaks. Each contact arm is provided with a powerful blow-out magnet, which reduces the arcing to a minimum and makes the maintenance of an arc impossible.

The whole construction has been made as compact as possible, every care being used to make this controller peculiarly applicable to crane use, while it answers equally well for the operation of elevators, hoists, and other classes of work where series motors are used intermittently.

Calculating Automatic Time Stamp for Telephone Switchboards.

No argument is necessary to prove the advantages to be gained by the employment of an accurate automatic time-recording and calculating machine in connection with the operation of telephone toll lines. A new invention for this purpose called the Timemometer is being put upon the market by the Automatic Stamp Company,



FIGS. 1 AND 2.—AUTOMATIC TIME STAMP.

of 160 Congress Street, Boston, Mass. The timemometer is the invention of Mr. John C. Wilson, of Boston, Mass., and is an adaptation of the automatic time stamp, to print the exact hour, minute, quarter minute or second, A. M. or P. M., and the date when a toll line conversation begins and when it ends, and to calculate and print the elapsed or intervening time to a quarter of a minute, or to the exact second as required.

FIGS. 3 AND 4.—TWO STYLES OF TIMEMOMETERS.

The Timemometer is made in three forms, one of which, model No. 3, is shown in Fig. 3. Models No. 1 and No. 2 may be fitted with either wheel or type-dating devices, while model No. 3 is restricted to the use of the latter. The other models are shown in Fig. 4. In timemometer model No. 1 the time is not visible, while models No. 2 and No. 3 are provided with visible clock dials and

with hands which move in unison with the time-printing hands, these machines thus serving both as time pieces and stamps.

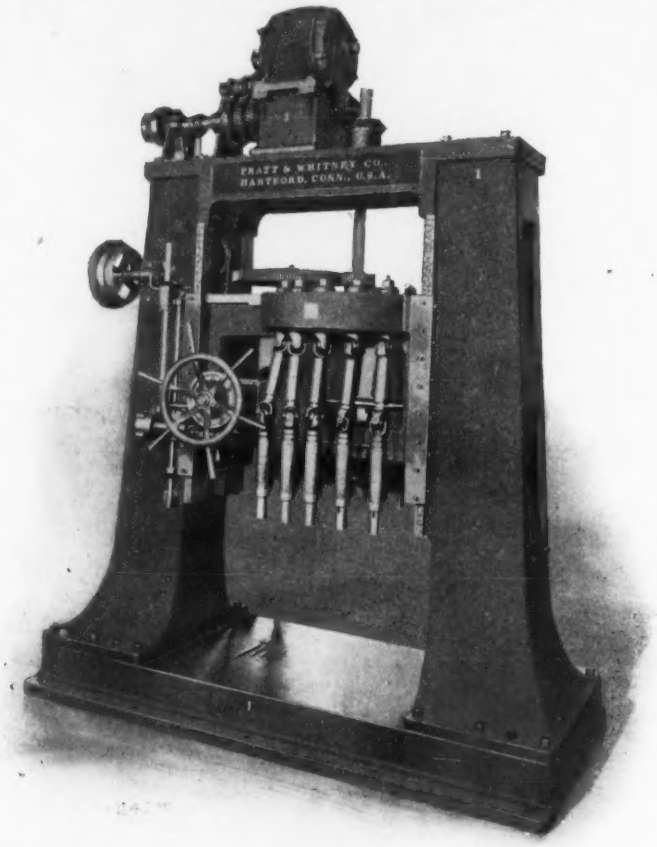
Model No. 2, although generally similar to model No. 1, is larger and has its visible clock dial placed perpendicularly in front, while model No. 3 is rectangular in shape and has a visible clock dial in a horizontal position on top. Models No. 1 and No. 2 print upon the bottom of the toll ticket, and are operated by a blow, while model No. 3 prints upon the top of the toll ticket, and is operated noiselessly by a press lever, which moves the ink ribbon forward automatically at each operation. Either model may be used also as an automatic time stamp for time stamping letters, telegrams, orders, etc.

Model No. 3 is especially adapted to be fitted into the telephone switchboard shelf, so that its base will be on a level with the shelf, the operating lever being underneath the same; or it may be placed upon a pedestal or other suitable support. Its ink ribbon is 24 ft. in length, and feeds automatically and a new ribbon may be easily inserted at any time.

The machines are all very strongly made and finely finished. The clocks are good timekeepers, are enclosed in dust-proof cases, especially model No. 3, and are not interfered with in the slightest degree by the operation of printing. Models No. 1 and No. 2 do not print seconds, but are arranged to print the actual time and the elapsed time to a quarter of a minute upon a toll line slip or ticket, as shown in Fig. 1. Model No. 3 may be arranged to print a time record similar to that of models No. 1 and No. 2, or to print the actual time and the elapsed or intervening time to the exact second, as shown in Fig. 2.

Adjustable Multi-Spindle Drill.

The Pratt & Whitney Company, of Hartford, Conn., has added a number of new types of adjustable multi-spindle drills to its already long list of machinery designed for drilling simultaneously a number of holes in electric car motor frames, automobile hubs, flanges



MULTIPLE-SPINDLE DRILL.

and other work of a similar character. The whole series of these machines have been remodeled, making them more rigid and convenient to handle than before and some new features have been added, making the machines more suitable for general use. The standard heads are built in two shapes, square and rectangular.

The new type, which is illustrated herewith, is one designed especially for drilling ten holes simultaneously in the steel frames of electric railway motors. The drill head is counterbalanced by weights within the columns, is fed automatically and has an automatic stop for the feed motion. The adjustment for position of the head is by hand. The spindles are all driven through universal couplings from the center gear and may be set in any required position by means of adjustable arms clamped to the under side of the drill head. The spindles are made to take the No. 4 Morse taper shanks and have ball-bearing thrust collars. They have an independent vertical adjustment by rack and pinion of 4-inch in order to compensate for different lengths of drills or to enable the drilling to be done at different levels, if desired. The vertical travel of the drill head is 24 inches.

The largest cluster of holes which this machine with a rectangular head will drill is a rectangle 40 inches by 32 inches, the smallest, a rectangle 24⅝ inches by 13½ inches. With a circular head the largest cluster is a circle 37 in. in diameter and the smallest a circle 18 inches in diameter. The least distance between any two spindles is 4¾ inches and the greatest distance between the ends of spindles and base plate is 52 inches, the surface of the latter being 62 inches by 50 inches. The weight of the machine is 28,000 pounds. This machine is selected merely as a type of the class of machines built by this company and applicable to electrical manufacturing purposes. A number of these machines are already in use in electrical manufacturing plants.

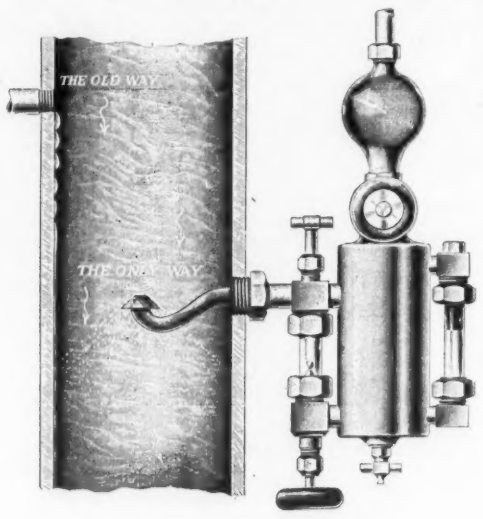
Cylinder Oil Atomizer.

The device shown herewith has for an object to atomize the cylinder oil fed to an engine so that the steam will carry it to all parts. By this means it is claimed a saving of oil is accomplished, a perfect lubrication is maintained and there is less oil to be extracted from the exhaust in order to use the condensed steam again.

The device delivers the oil in a thin sheet to the steam having the greatest velocity, distributing the oil in a vapor through the steam and delivering it to all parts of the cylinder, thereby oiling the upper part as well as the sides, and so effectually that it is claimed one-half the oil ordinarily used will, with this device, oil the cylinder better than the amount usually required.

This cylinder oil vaporizer consists of a bronze casting so shaped that the outlet is on a level with the inlet opening, one end of which is tapped into the steam pipe, as shown in the cut, which end is also tapped for the lubricator or oil pump. The action of the device is as follows:

Oil flows in from the lubricator and, passing through the body of the vaporizer, is heated to the temperature of the steam. By the time it reaches the outlet at the top of the cone it is sufficiently thin and limpid to spread out over the surface in a thin film, and as it reaches the lower edge of the cone is carried along with the steam.



OIL ATOMIZER.

This cone is always small enough to go through the opening in the steam pipe; all the work necessary to install it is to unscrew the lubricator connection, tap the pipe for the atomizer, screw into place, then screw the lubricator back into the atomizer.

This atomizer is the invention of Mr. C. E. Sargent, Chicago, and is manufactured and for sale by the North Chicago Machine Company, North Chicago, Ill.

Automatic Electric Pump.

The accompanying cut shows a new electric pump manufactured by the Automatic Electric Pump Company, 170 Broadway, New York. The water cylinders are of the standard double-acting duplex type used in pumping machinery for many years; the pistons have flexible packing which may be cheaply and quickly renewed when necessary. The mechanism for driving the pistons, and for transmitting the power of the motor to the pump, are combined and enclosed in a case containing oil enough to run a year without refilling. By this means the necessary lubrication of all working parts is automatically secured. The motor, as may be seen, is connected directly to the pump, without the intervention of belts, spur-gearing or similar devices.

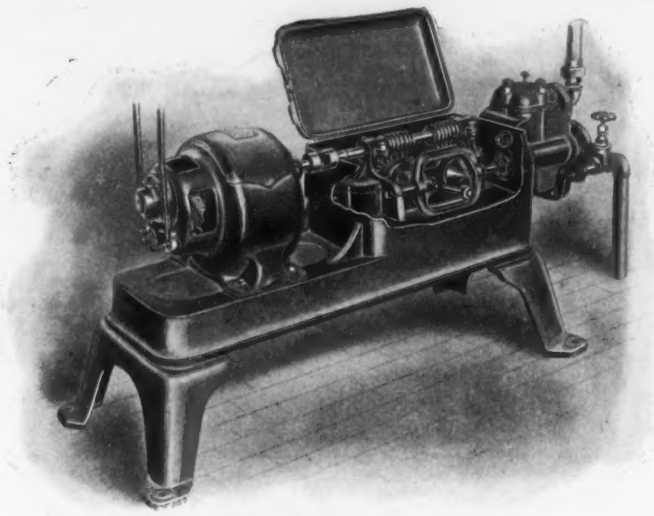


FIG. 1.—ELECTRIC PUMP.

As illustrated very clearly in the cut, the power of the motor is transmitted through a shaft and double worms to double-worm gears, and from cranks upon one of these gears to the yoke pieces which are connected to the piston rods. This makes an absolutely noiseless mechanism, and the double worms and gears eliminate all end thrusts. In fact, the mechanism is such that it dispenses with any necessity for attention or mechanical skill, which especially suits it for domestic service. These worms reduce the high speed of the motor to a moderate speed for the pump, thus insuring a smooth and noiseless pumping action. The motor is connected to the pump by means of a universal compensating clutch, securing flexibility to the motor and worm shafts, and avoiding friction loss.

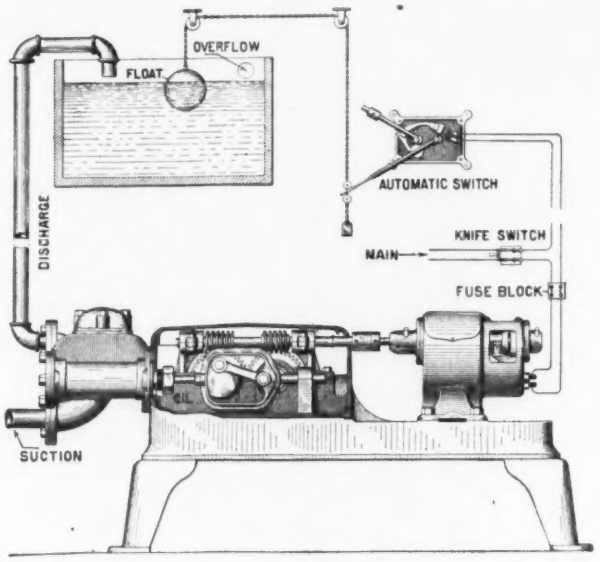


FIG. 2.—VIEW OF PUMP AND CONNECTIONS.

A very important feature in the installation of these pumps is the electric switch placed at the tank for starting and stopping the pump automatically. Thus the tank is always kept full without requiring the services of an attendant. Of course, this is only necessary where automatic operation is required, as the pumps are especially advantageous for any class of pumping, whether or not automatically controlled.

Every pump comprises a bed plate, with the pump, motor and mechanism, properly assembled and bolted thereon, ready for starting, and is mounted upon four legs ready to be set in place where desired without any foundation or preliminary work or expense. For this reason the pump as shipped can be located, connected up and started as soon as received without any delay, labor or expense other than that required for the requisite wiring and piping.

De Forest Wireless Telegraph Company.

The De Forest Wireless Telegraph Co. of Canada has been incorporated in Toronto and two stations at Toronto and Hamilton, 40 miles apart over the lake, have been opened and are now in commercial operation. A public demonstration accompanied the opening of communication at which there were present city officials, professors of the Toronto University, officials of the Canadian Pacific, Grand Trunk, Canadian Pacific Telegraph, Great Northern Telegraph Company, and others. It is reported that several prominent men of the Canadian General Electric Company are financially interested in the enterprise, and that the Canadian Company proposes to establish communication on the Pacific Coast from Vancouver north, ultimately reaching Dawson, and is endeavoring to secure governmental subsidy for this work. Stations are also to be opened by the Canadian Company this spring on Lake Huron. It is stated that signals have been received at Toronto from the Glace Bay Station.

The De Forest Company announces that it has purchased land on the lake at Buffalo, Cleveland and Grosse Isle, Detroit, and that stations are now under way at these three cities, that at Buffalo to be completed first. All three of these stations are to be of 10-hp and will comprise two masts at each station, each of 200 feet in height, placed 100 feet apart. Between the tops of these masts a horizontal wire supports 20 vertical wires which converge into the station house placed midway between the two masts. The plans of the company are to carry on private "leased wire" service between these three cities, and it is stated that arrangements have already been completed with newspapers in Cleveland and Detroit for transmitting their local news at night between these cities.

It is also announced that a contract for equipping the boats of the Cleveland and Buffalo line has been obtained. The Detroit and Buffalo line boats will make use of the service upon the completion of the Detroit station and it is hoped to have wireless apparatus on a large number of lake carriers before the close of this season, and to get the above three stations into operation early in May, after which other small stations will be erected at Port Huron, Sault Ste. Marie, Mackinac, Marquette and Duluth. It is stated that a site for the Chicago station has been obtained near Evanston, and there a tower of 200 feet in height will be erected, to be followed next year by two others of similar height, the three to comprise a very powerful station for operating with St. Louis during the World's Fair. The Chicago station will completely cover Lake Michigan, Milwaukee and St. Joe being also in the circuit. At White Fish Bay and Grand Island, Lake Superior, are harbors of refuge into which vessels are frequently driven by storm, and where they lie sometimes for several days without means of communicating with their owners. It is under consideration to connect these two points with the Soo and Marquette respectively by wireless during the summer.

A demonstration plant has been installed at Armour's stock yards and another station upon the roof of the Home Insurance Building, La Salle Street, Chicago, where are Armour's general offices. The officials of Armour & Co. are reported to be much interested in a proposition to connect their offices at Chicago and Omaha, and from Omaha to Kansas City, as with wireless telegraphy they will be enabled to save several thousand dollars per year which is now paid for leased wires to the Western Union Telegraph Company. It is expected that the Northwestern Commercial Company of Seattle, Wash., will establish communication by this system with its stations in Eastern Siberia.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was practically unchanged, there being a good demand for short periods and liberal offerings. The closing rates were 5½@5¾ per cent. for 30 to 90 days, and 5@5½ per cent. for four, five and six months. Several factors of a depressing nature affected the stock market and caused a lowering of prices. The bank statement of the week previous was unfavorable and during the past week the banks lost money to the U. S. treasury on a fairly large scale, while shipments of funds have also been in progress to the interior in answer to the demands connected with April dividend disbursements. In the industrial group Amalgamated Copper was the active member, the stock being successfully raided by the bears, and it declined from 73¾ to 66½. In the tractions, Metropolitan Street Railway received some support, the revelations of the pending court proceedings growing out of the recent vicious attack on the company having a tendency to diminish any feeling of apprehension about its position. It reached 139 during the week, but closed at the lowest figure of the week—134¾—this being a net loss of 2¼ points. The shares sold aggregated 30,800. Brooklyn Rapid Transit was irregular, closing at 65¼, which was 2¼ points below the closing price of the week previous. This stock fluctuated between 64½, the lowest figure, and 68⅛, the highest. The steel stocks were dull and rather heavy. Electrics also showed the effect of the adverse influences which weighed down the general market, General Electric closing at the lowest quotation of the week, namely, 190¼, representing a net loss of 6½ points. Westinghouse is quoted at 207, being a loss of one point, and Western Union 87⅜, a loss of 1⅜. Following are the closing quotations of March 31:

NEW YORK.

	Mar. 24.	Mar. 31		Mar. 24	Mar. 31
American Tel. & Cable	82	81	General Electric	192⅛	188
American Tel. & Tel.	163¾	159†	Hudson River Tel.	..	..
American Dist. Tel	35	32	Metropolitan St. Ry.	134¾	135¾
Brooklyn Rapid Transit	65¾	66	N. E. Elec. Veh. Trns.	⅜	⅛
Commercial Cable	..	..	N. Y. & N. J. Tel.	164	165
Electric Boat	27	23	N. Y. E. V. T. Co.	9⅛	8¾
Electric Boat pfd	40	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	2⅜	1⅛	Western Union Tel.	88	87⅜
Electric Vehicle	8⅛	8⅜	Westinghouse com	205	198
Electric Vehicle pfd	14	13	Westinghouse pfd	200	198

BOSTON.

	Mar. 24.	Mar. 31		Mar. 24	Mar. 31
American Tel. & Tel	164	158⅛	Western Tel. & Tel. pfd.	98¾	97⅛
Cumberland Telephone	..	..	Mexican Telephone	2¼	2⅛
Edison Elec. Illum.	..	..	New England Telephone	138½	139*
General Electric	..	189½	Westinghouse	102	100
Western Tel. & Tel	22	21	Westinghouse pfd.	..	100

PHILADELPHIA.

	Mar. 24.	Mar. 31		Mar. 24.	Mar. 31
American Railways	..	50¼	Phila. Traction	97¼	97
Elec. Storage Battery	77*	77*	Phila. Electric	6⅞	6¾
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9	9	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Mar. 24.	Mar. 31		Mar. 24.	Mar. 31
Central Union Tel	..	..	National Carbon pfd.	98½	98⅛
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry	212	212	Union Traction	9⅛	9
Chicago Tel. Co	..	..	Union Traction pfd.	42	..
National Carbon	21½	24⅜			

*Asked. †Ex Dividend.

COMMERCIAL CABLE.—The Commercial Cable Company has filed with the Massachusetts Commissioners of Corporations a certificate of condition as of March 1, 1903. Compared with the previous year it is as follows:

ASSETS.

	1903.	1902.
Cables, land lines, and plants	$37,277,442	$35,539,220
Spare cables, stocks, supplies	418,207	352,714
Patent rights	.....	564
Investment in stocks and bonds	4,784,847	4,449,796
Cash and debts receivable	1,191,157	1,498,342
Total	$43,671,655	$41,840,638

LIABILITIES.

Capital stock	$13,333,300	$13,333,300
Debts, bonds, etc.	20,774,771	21,015,717
Reserves	5,794,719	5,111,017
Extension of cables and plant	3,621,334	2,250,000
Balance profit and loss	147,529	130,604
Total	$43,671,655	$41,840,638

ANOTHER HUDSON RIVER TUNNEL.—The Hudson & Manhattan Railroad Company, of New York City, has been incorporated in New York State with a capital of $3,000,000. It is to construct a tunnel railroad approximately one mile long from Broadway and Cortlandt Street underground in New York City and under the bed of the Hudson River to the boundary line of the State of New Jersey, there to connect with the railroad of a New Jersey corporation extending westwardly to a point in Jersey City. The directors are George P. Lester, of Bloomfield, N. J.; Howard Slade and William H. Siegel, of New York City; Clinton Graham, of Flushing; Robert Maroney, Charles H. Aron, James Davidson and A. F. Richter, of Brooklyn, and A. B. Proctor, Jr., of Boonton, N. J. William G. McAdoo, president of the New York & Jersey Railroad Company, which company is to build the trolley tunnel from Fifteenth Street, Jersey City, to Morton Street, New York, is interested in the company chartered.

WASHINGTON RAILWAY & ELECTRIC.—The Washington (D. C.) Railway & Electric Company shows as follows for the year ended December 31:

	1902.	1901.	Changes.
Gross	$2,325,775	$2,162,560	Inc. $163,215
Expenses	1,251,814	1,187,449	Inc. 64,365
Net	$1,073,961	$975,111	Inc. $98,850
Other increase	19,644	16,015	Inc. 3,629
Total income	$1,093,605	$991,126	Inc. $102,479
Charges and taxes	892,476	892,476	.....
Surplus	$201,129	$98,650	Inc. $102,479

This includes properties owned and operated. The company represents large traction and lighting interests in Washington.

CONSOLIDATION AT LOS ANGELES.—The Edison Electric Company, of Los Angeles, Cal., is soon to reach out again and gather in more of the lighting plants of surrounding towns. This announcement is in line with the consolidation policy inaugurated last fall, when a $10,000,000 bond issue was made and many power plants east of Los Angeles in the Southern California district were absorbed. Now negotiations are reported looking toward merging the United Electric, Gas & Power Company, which controls plants at Santa Barbara, Santa Monica, Ocean Park, Redondo and Long Beach. The latest work of the Edison Electric Company is its Kern River plant. The scheme, when complete, will comprise twenty-six tunnels. The plant is so located that with only 800 lineal feet of flume the water is conducted to the wheels. Work has now begun on a second Kern River plant, involving the construction of over eleven miles of canal.

COMBINATION IN CANADA.—The combination of the Quebec & Jacques Cartier Electric Company and the Quebec Railway, Light & Power Company has about culminated. Mr. E. McMillen, of New York, has resigned the presidency of the former company and has been succeeded by J. M. McCarthy, of Quebec. It is learned that a third company is in process of formation and will take over the two Quebec electric concerns. The new company will be known under the name of the Quebec Railway, Light & Power Company and will ask for powers to issue $500,000 additional preferred stock, with which to pay off the floating debt of the two Quebec companies, which amounts to about $300,000, and will then have a reserve fund of $200,000 for operating expenses, improvements, etc.

NEW ENGINEERING FIRM.—The firm of Mackenzie, Quarrier & Ferguson has been incorporated under the laws of the State of New York for the purpose of acting as contracting engineers. The concern includes the names of W. P. Mackenzie, formerly manager of the New York offices of the Harrisburg (Pa.) Foundry & Machine Works, and S. F. Ferguson, lately Boston sales agent for the Ludlow Valve Company, of Troy, N. Y. The new firm—which is capitalized at $50,000—will represent the Harrisburg company in the East.

CINCINNATI ELECTRIC MOTOR COMPANY.—The stockholders of the Cincinnati Electric Motor Company have decided to increase the capital stock from $50,000 to $250,000, half 6 per cent. preferred and half common. The company will select a site near Norwood and erect a factory to cost $20,000.

NATIONAL CARBON.—The following item appears in the financial papers: For over eighteen months, General Electric interests have been steadily buying National Carbon common and preferred, and interests closely identified with the company now own a practical majority of the shares.

CHICAGO & MILWAUKEE ELECTRIC.—According to dispatches from the West the Chicago & Milwaukee Electric Company has increased its capital stock by $4,700,000 for equipment and better service.

TRACTION & POWER SECURITIES.—The first annual general meeting of the Traction & Power Securities Company, Ltd., was held recently at the offices, Westinghouse Building, Norfolk Street, London, Mr. Robert Benson presiding. The report showed that the profits suffice (1) to pay for the period of seventeen months a 6 per cent. dividend on the capital as paid up; (2) to pay off preliminary and formation expenses and leave it with a perfectly clean balance sheet; (3) to start a reserve account of £10,000 and carry something handsome forward beside. The amount carried forward (after allowing for income tax) will be about £7,500, which, added to the reserve, is equal to about 4 per cent. on the paid-up share capital of £421,000. The idea of the concern is to assist in the financing of new enterprises based on electric light and power, especially such as may use Westinghouse apparatus abroad, and may wish to place securities to promote the work. The company has apparently a very bright future, as a number of sound enterprises are coming forward.

NEW MANHATTAN STOCK.—The $55,200,000 stock of the Manhattan Railway Company just listed is the stock issued according to the rental agreement with the Interborough Rapid Transit Company, which has leased the Manhattan Company, and takes the place of the Manhattan capital now outstanding. Interborough Rapid Transit Company is a railroad corporation, incorporated May 6, 1902, under the provisions of the general law of the State of New York. It is organized, principally to maintain and operate the electrical system of the Rapid Transit Railroad at present being constructed by John B. McDonald, under contract with the city of New York, which railroad has been leased to the Interborough Rapid Transit Company for the term of fifty years, with the privilege of a renewal for the further term of twenty-five years, and which railroad it will operate as soon as the same is completed. The authorized capital stock of the company was fixed in its certificate of incorporation at $25,000,000.

THE ST. LOUIS RAPID TRANSIT COMPANY has under consideration a proposition to issue $20,000,000 in 5 per cent. refunding gold bonds. The purpose of the issue is to take up certain 6 per cent. obligations, thus saving 1 per cent. The proposition is purely a refunding one, and will not increase the indebtedness of the company in any respect. One of the obligations to be taken up with the proposed bond issue is the collateral trust notes, amounting to $6,000,000, and drawing 6 per cent., which mature in November, 1904. Of the new issue it is proposed only to dispose of from $5,000,000 to $5,500,000 in 1903. The proceeds will be applied to a funding obligation of the company of $2,225,000, and drawing 6 per cent., and to the purchase of equipment. The remainder of the issue will be held as a reserve, to take obligations as they mature. The issue will be secured by certain bonds and stocks of the United Railways Company, now held in the treasury.

LITTLE ROCK REORGANIZATION.—The Little Rock (Ark.) Railway & Electric Company has been reorganized. The company is in succession to the Little Rock Traction & Electric Company, incorporated June 8, 1895, and is the result of the recent transfer of the management of the property from the Union Securities & Electric Company, of Boston, to Isidor Newman & Son, of New York and New Orleans. The incorporators and directors are as follows: D. H. Cantrell, president; J. H. Loughborough, vice-president; H. T. Bunn, secretary; W. H. Thorp, treasurer. The capital stock is $2,250,000, compared with $500,000, the capital of the original Little Rock Traction & Electric Company. The stock is divided into two classes, $750,000 preferred and $150,000 common stock. All the preferred stock may be redeemed by the company at its option at 110.

CHICAGO ELEVATED.—It is expected by stockholders in the South Side Elevated that about $6,500,000 in new securities will be issued by the company to build the extensions contemplated in the ordinance just passed by the Council. The new securities will undoubtedly be in the form of stock, it being the policy of the management to avoid bonded debt. The road has outstanding now only $750,000 4½ per cent. bonds out of an authorized issue of $1,500,000. The improvements contemplate the completion of the third track from Twelfth to Forty-third Street and extensions to the stock yards and Lake Avenue over the junction railway and an Englewood branch.

STROMBERG-CARLSON STOCK.—The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, has filed with the Secretary of State of New York a certificate of increase of capital stock from $3,000,000 to $4,500,000. The certificate is signed by Hiram W. Sibley, John C. Woodbury and Charles E. Angel.

U. S. STEEL.—Material for electric street railways, equipment and rails is placed at about 7 per cent. of the output of the U. S. Steel Corporation. There is also a variety of electrical work in the miscellaneous 14 per cent.

DIVIDEND.—The New England Telephone & Telegraph Company has declared a regular quarterly dividend of 1½ per cent., payable May 15.

Commercial Intelligence.

THE WEEK IN TRADE.—The one word "improvement" tells the story of last week's trade conditions, and is applicable to the weather, crops, distributive trade and even collections. The price situation, according to the summary of one of the mercantile agencies, shows few important changes, but so far as actual indications are concerned, demand shows no hesitancy on account of increased cost. Railway earnings continue excellent, those for the third week in March showing the large gain of 17 per cent. in gross. Heavy rains in the West and Northwest have put the ground in good condition for planting, and the weather is better at the South. Winter wheat crop reports are uniformly favorable, and are far better than last year's. Retail trade is improving with the warmer, dry weather and the approach of Easter. Industry is hopefully active, although labor agitation menaces some important lines. Iron and steel are active and the demand still exceeds the supply. The tendency is still toward increased strength in finished products. Large sales of steel rails to traction companies are noted. Interesting features were the sale of some Lake Superior charcoal iron to France, and the report from Providence that large orders for finished machinery for export to Italy have been received. Building material of all kinds is active and 30 to 50 per cent. higher than a few years ago. In copper there was little done. At the nominal figure of 15⅜c. there were no sellers, but after the interruption of the fictitious rise there were plenty of sellers at 15⅛c., but no buyers. Quotations are entirely nominal as follows: Lake and electrolytic, 14½c. a 15c.; casting stock, 14¼c. a 15c.; standard, 13¾c. The business failures for the week ending March 26, as reported by *Bradstreet's*, numbered 175, against 194 the week previous, and 183 the corresponding week last year.

EQUIPMENT FOR AUSTRALIAN NEWSPAPER PLANT.—Davis Syme & Company, proprietors of the *Melbourne Age and Leader*, which concern operates the largest newspaper printing plant in the Antipodes, have let a contract to the electrical engineering and contracting firm of Noyes Brothers, Melbourne and Sydney, for the complete equipment of their works. The contract calls for specially designed Westinghouse apparatus for driving printing presses and auxiliary machinery. The whole of the equipment will be driven without belting or shafting, as the motors will be direct-connected to the machines which they are intended to operate. All wires will be run in insulated tubing and no joint will be allowed in wiring. The motors will be arranged for control, both by no-voltage release and double-pole automatic overload circuit-breakers. The elevators in the building will also be driven by electricity. The equipment will also generate current for lighting purposes.

EQUIPMENT FOR AUSTRALIAN TANNERY.—The Westinghouse interests, represented in Australia by Noyes Brothers, of Melbourne and Sydney, have secured a contract for the complete electrical equipment of the large tannery at Foots-cray, near Melbourne, operated by Michaelis Hallenstern & Co., Proprietary, Limited. This is the first contract ever let in Australia for the complete electrical equipment of a private industrial plant. The alternating system will be employed. The equipment will comprise Westinghouse engines and three-phase generators, several motors, switchboards, etc. The boilers and superheaters will be furnished by Babcock & Wilcox. The condensers and feed pumps will be built by the International Steam Pump Company, the Worthington branch having secured the contract.

AMERICAN EQUIPMENT FOR QUEENSLAND.—Westinghouse equipment is to be installed on an extensive scale in the locomotive shops now under construction at Ipswich, Queensland, for the government railway. The plant will have a capacity of 1,400 hp. It will be the most important electrically-operated manufacturing plant in Australasia. There will be three 300-kw generators direct-connected to engines of 450 hp each. The motors, two-phase type, will be 150 in number, varying in capacity from 5 hp to 100 hp. Several heavy machine tools will be of Niles-Bement-Pond build, driven by motors. The entire contract for the equipment has been allotted to Noyes Brothers, Melbourne and Sydney.

NEW ZEALAND LIGHTING PROJECT.—The Eltham (New Zealand) Borough Council has adopted an electric lighting scheme submitted by Miller, Wilson & Co., of Wellington. Arrangements are being made to finance the undertaking and contracts for equipment will shortly be let.

MEXICAN WATER POWER TO SMELT ALUMINUM.—Valetin Elcoro y Cia Sen C. Apartado 161, Mexico City, are acting as purchasing agents for a Mexican concern which is about to construct a large aluminum smelting plant to be operated by water power.

NEGOTIATIONS FOR ST. PETERSBURG TRACTION.—Notwithstanding the fact that the Russian Minister of the Interior rejected the proposition of the Verner-Balinsky syndicate regarding the construction of the St. Petersburg electric traction system, M. A. Verner, of Pittsburg, who, with Sellers McKee, of the same Pennsylvania city, is primarily interested in the syndicate, when seen at the Holland House by a representative of ELECTRICAL WORLD AND ENGINEER, said he was far from disheartened at the present decision, and that he would renew negotiations on the first favorable opportunity. The St. Petersburg municipal authorities have been particularly aggressive in their attitude toward foreign competitors for the franchise in general, more especially the American syndicate. The *Nuova Vremya,* the leading Russian newspaper, has also been very bitter against the contemplated Yankee invasion. The construction of the St. Petersburg system, according to the plans submitted by Mr. Verner and his associates, would result in an estimated expenditure of no less than $60,000,000. The project would involve the building of a complete network of trolley lines in the Russian capital, the drying up of the St. Catherine's Canal, the construction of 16 large bridges across the River Neva, the purchase of a large hospital to serve as a central power station, and the building of another hospital, which alone would cost $3,000,000.

AUTOMOBILE COMBINATION.—The officers of the Association of Licensed Automobile Manufacturers, a recently formed organization, are Frederick L. Smith, of the Olds Motor Works, Detroit, president; Barclay H. Warburton, of the Searchmont Automobile Company, Philadelphia, vice-president; Henry B. Joy, of the Packard Motor Car Company, Detroit, secretary and treasurer, and George H. Day, of the Electric Vehicle Company, Hartford, general manager. The association secures to its members the use of the Selden hydrocarbon automobile patent, the suit over which was decided recently in favor of the Electric Vehicle Company against the Winton Company, and the firm of Smith & Mabley. Four hundred other patents are secured by the association, one of the chief objects of which is to save $20,000,000 that would be spent in litigation on the basis of the cost of the fight over the Selden patent. In the organization are included about thirty concerns, among them being the Winton, Olds Mobile, Packard, Peerless, Searchmont, Haynes-Apperson, Apperson Brothers, Locomobile, Knox Auto-Car, Pierce, Pan-American, International, United States Long Distance, Pope-Robinson, Waltham, Stevens-Duryea and Franklin Companies. Litigation falling upon any member is undertaken by the association.

ANOTHER MEXICAN WATER POWER PROJECT.—A concession has been secured by Leon Pegot, of Mexico City, for the purpose of utilizing the waters of the River Santiago, State of Jalisco, for motive power. The franchise permits the use of 10,000 litres per second. The locality selected by Mr. Pegot for his hydraulic works and the scope of his concession begins where the franchise held by the Hidraulica Mexicana Company, the Mexican Hydraulic Company, terminates, and continues to the point where the Martinez Negrete & Enrique Schondube grant commences. The terms of the concession are the same as those embodied in all similar federal water grants. Surveys must begin within six months and plans must be submitted to the proper Mexican authorities within a period of twelve months. Free importation of material and exemption from taxation other than the stamp tax are allowed for five years. The concessionaire guarantees compliance with the obligations assumed by a deposit of $5,000 in bonds of the 3 per cent. silver debt, constituted in the federal treasury.

TELEPHONE FRANCHISE FOR MEXICO CITY.—Jose Sitzenstatter, of the City of Mexico, has been granted a concession for the establishment of a system of underground or aerial telephones in the Mexican capital and in the federal district. The franchise, according to Mexican advices, may be taken advantage of by any company which Mr. Sitzenstatter may organize. In granting the concession the Mexican authorities reserve to themselves the right to allot other franchises for similar systems. The concession requires the payment of $10,000 annually after the sixth year on to the fifteenth year, and from the beginning of the sixteenth year until the termination of the thirty-first year the contract stipulates that $15,000 must be paid yearly to the federal government.

TO BUILD LARGE ELECTRICAL MINING PLANTS.—Extensive works are to be constructed in the Pittsburg district for the purpose of building the "New Era" gold extraction plants for placer and river bed mining—the invention of Erastus S. Bennett, formerly of Denver, Colo., now at 52 Broadway, New York. The works will be electrically operated. Eventually they are expected to cover 10 acres and have a capacity of turning out three "New Era" plants daily. The equipment for each Bennett plant will consist of a 200-hp boiler, a 200-hp direct-connected engine, a 200-hp dynamo, a 1,600-gallon-per-minute pump, a 125-hp, direct-current motor, a 25-hp series motor, a 20-hp standard motor, two 5-hp series motors, a 5-hp standard motor and four 7½-hp series motors.

ELECTRICITY IN NAVY YARDS.—The United States naval appropriation bill provides $30,000 for electrical extensions at the New York Navy Yard and $75,000 for the same purpose at League Island. At the Norfolk yard $20,000 will be spent for electrical work. A large amount is to be spent on the power plant at Charleston, S. C. At Mare Island, Cal., $40,000 will be spent on a light and power plant and $25,000 on extensions of the electrical shops. The naval powder depot at Dover, N. J., is to expend $19,600 for four electric elevators, etc. A large amount is to be spent in extending the Puget Sound yard electric light plant. Electric cranes are to be put up at the Boston and Norfolk yards.

ORDERS FOR WARREN ALTERNATORS.—The following are recent shipments of Warren alternators from the works of the Warren Electric Manufacturing Company, at Sandusky, Ohio: Hulton Dyeing & Finishing Company, Philadelphia, Pa.; Camden, S. C., three; De Forest Wireless Telegraph Company, New York, five; Portland, Ind.; Charleston, W. Va.; Battle Creek, Mich.; Greenwich, Ohio; Wolcott, Ind.; Charleston, Ill.; Davenport, Wash.; Port Deposit, Md.; Durand, Mich.; Hopewell, N. J., three; Chelan, Wash.; Soda Springs, Idaho; Big Springs, Texas; Ada, Ohio, two.

EXTENSIONS PROJECTED TO MEXICAN POWER.—The Electric Power Transmission Company of the State of Hidalgo, Mexico, is considering the question of augmenting its capital so as to increase its electric installations. The present capital of the concern is $700,000 Mexican. The company paid 17 per cent. dividend on this sum last year. Another Mexican concern which contemplates an extension to its system is the San Ildefonso Compania Explotadora de Fuerzas Hidro-Electricas.

BALL ENGINE ORDERS.—The Institute for Blind, Janesville, Wis., is installing a direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine, and the Northern Electric Company, Madison, the generator. The Mineral Point Zinc Company, Mineral Point, Wis., has recently installed a direct-connected unit, the engine being furnished by the Ball Engine Company and the generator by the Crocker-Wheeler Company, of Ampere, N. J.

PROPOSED BIG MEXICAN INTERURBAN RAILWAY.—The construction of an electric interurban railway is projected between Mexico City and Puebla. The distance between these two cities is 116 miles. The Federal District Street Railway Company, which operates the electric traction system in the Mexican capital, has made application to the Mexican authorities for the necessary franchise to build the road.

JAPANESE CONTRACTS OPEN.—Frazar & Company, of Japan, 63-65 Wall Street, are at present estimating on two electric lighting contracts pending in the Mikado's kingdom. They are also figuring on an extensive electric traction contract. The Frazar people do not represent any particular American manufacturing concern of electrical equipment, etc., in the Far East. They purchase in the open market here.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, through its Montana office, has sold to the Bismark Nugget Gulch Consolidated Mining Company a complete power equipment consisting of inductor alternators, induction motors, hot wire voltmeters and ammeters, lightning arresters and the attendant controlling and regulating apparatus.

THE NILES-BEMENT-POND COMPANY, Hamilton, Ohio, has secured a contract to furnish $130,000 worth of tools to the new locomotive plant of the Locomotive & Machine Company, Montreal, which will be under the management of Americans. Nearly all the tools will be of large size and many of them will be electrically-driven.

THE SALT LAKE ELECTRIC SUPPLY COMPANY, Utah agent for the Nernst Lamp Company of Pittsburg, Pa., has recently secured the lighting contract for the large department store of the Keith-O'Brien Dry Goods Company, of Salt Lake City. There were several competitors for this contract, but the Nernst lamp won.

EQUIPMENT WANTED FOR MEXICAN TRACTION.—Contracts are about to be let for the construction and equipment of an electric traction system in the City of Aquascalientes, a place of some 35,000 inhabitants, located in the Mexican State of the same name.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY has sold a complete equipment of telephones and material to the Glasford & Canton Telephone Company, of Glasford, Ill.

MONTEVIDEO TRACTION PROJECT.—The construction of a new electric traction system is pending in Montevideo, Uruguay. The road is projected by Ramez Suarez, of the same South American city.

ROSARIO TELEPHONE SYSTEM.—Considerable alterations and improvements in the Rosario (Argentine Republic) telephone system are being contemplated.

ELECTRICAL EQUIPMENT FOR MILLIKEN STEEL PLANT.—The structural steel plant now being built in Staten Island for Milliken Brothers, 11 Broadway, New York, which concern has furnished the steel for several foreign electric power plants, is to be furnished with considerable electrical equipment. The machine tools, nearly $100,000 worth of which have already been contracted for with Manning, Maxwell & Moore, 85-89 Liberty Street, New York, will be electrically driven. Manning, Maxwell & Moore have also secured the contract for the overhead traveling cranes. There will be fifteen all electrically operated. The Shaw Electric Crane Company, of Muskegon, Mich., will build the cranes as well as the motors. The contract calls for three equipments, each to have a capacity of 10 tons and to operate over a 100-ft. span. The hoist will be 35 ft. The motors are to be of 26-hp capacity each. These cranes are intended to be installed for the purpose of handling structural material outdoors at the Milliken plant. Twelve cranes of 5-ton capacity each to operate over a span of 25 ft. 6 in. and to have a hoisting capacity of 16 ft., have also been requisitioned. These cranes will be operated by 16-hp motors. The value of the contract is about $50,000.

MANHATTAN ELEVATED.—The transfer of the Manhattan Elevated system to the Interborough Rapid Transit Company has taken place this week. The transfer will not make any great change in the working of the elevated system, but General Manager E. P. Bryan, of the Interborough, says that great efforts will be made to relieve the present congestion. General Superintendent Frank Hedley will direct the operation of the road. Auditor E. F. J. Gaynor, Treasurer D. McWilliams, and Vice-President Alfred Skitt will remain with the Manhattan Company until 1906. The latter, it is said, will not be entrusted with any duties relative to the operation of the road, but will serve only in an advisory capacity. In an interview General Manager Bryan is reported as saying that for relief purposes 500 cars built for the subway will in two months be used on the Second Avenue Elevated line, and the cars now in use on that line will be transferred to other lines. The subway cars are longer than the present elevated cars, and because of the sharp curves on the Third, Sixth and Ninth Avenue lines they would not be available except on the Second Avenue line.

WESTERN ELECTRIC NEW WORKS.—Note has already been made in these pages of the recent acquisition by the Western Electric Company of the Richmond property in Chicago on the lines of the Burlington & Western Indiana Railroads. It is 109 acres, at a price of $218,000. The cost, $1,200,000, of the structures planned by the Western Electric Company is exclusive of machinery, which will be installed in the buildings. The plans have already been made for a cable factory, comprising a group of one-story buildings with an aggregate floor area of about 150,000 square feet. Plans have also been made for a large machine shop and iron foundry ground. The present capacity of the power plant will be 4,000 hp and the works will employ about 1,200 hands. This undertaking is in addition to the present vast interests of the Western Electric Company. The company has invested $3,000,000 in buildings at its present principal site on the Chicago West Side, and is in process of laying out $500,000 on the Polk Street tract. This is of course outside of the amount of money represented by machinery and equipment.

THE VILTER MANUFACTURING COMPANY, builders of refrigerating and ice-making machinery, Corliss engines, brewers' machinery and bottling outfits, Milwaukee, Wis., has recently closed contracts with the following parties for Corliss engines: Shawmut Clay Manufacturing Company, Shawmut, Pa., 24 x 48; Garland & Williams, Devers, Tex., 18 x 42; W. Toepfer & Sons, Milwaukee, Wis., 12 x 30; W. W. Cargill Company, Green Bay, Wis., 16 x 30; Racine Trunk Company, Racine, Wis., 14 x 30; Great Northern Moulding Company, Chicago, Ill., 24 x 48; Hartman Trunk Company, Racine, Wis., 18 x 36; Winnebago Paper Mills, Neenah, Wis., 20 x 38 x 42 cross-compound; B. D. Eisendrath Tanning Company, Racine, Wis., 20 x 42; Wisconsin Bridge & Iron Company, North Milwaukee, 15 x 36; P. Becker & Company, Chicago, Ill.; 18 x 42; Skandia Furniture Company, Rockford, Ill., 22 x 42; Milwaukee Rubber Works Company, Cudahy, Wis., 22 x 42.

SOME A. D. GRANGER ORDERS.—The A. D. Granger Company, contracting engineers, 85 Liberty Street, New York, have taken a contract for two 75-hp. direct-connected engines for installation in the factory of Walter Ermmerich Company, at Park Avenue and Ilner Place, New York. The engines will be built by the Skinner Engine Company, of Erie, Pa. The generators will be manufactured by the C. & C. Electric Company. The Granger Company has also secured a contract for an 800-h.p. horizontal return tubular boiler plant, four units, 200-h.p. each, for installation in connection with the electrical plant of the Brooklyn Institute of Arts and Sciences. The boilers will be built at the Union Works, Erie, Pa.

SOME HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson, Engineering Building, 114 Liberty Street, have secured a contract for a 120-h.p. Harrisburg standard engine to be direct-connected to a 75-kw. General Electric generator, for lighting purposes in the plant of the Berlin (Conn.) Construction Company. The Cooper-Wigand-Cooke Company, which is building a plant at Delawana, N. J., for the manufacture of steel castings, has also placed a contract for a 150-h.p. Harrisburg standard engine for direct- connection to a 100-kw. generator to be built by the Crocker-Wheeler Company. This equipment will be used for power purposes.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY, of Meriden, Conn., has incorporated recently with the following officers: E. C. Wilcox, president; B. L. Lawton, vice-president and treasurer; B. C. Rogers, secretary. The business has hitherto been carried on as a partnership, and its product has become widely known. It has lately moved into a new plant where the company has a very fine equipment for the manufacture of telephones. They make every part entering into the construction of their apparatus and under the new régime will have every opportunity to enhance their reputation and extend their trade connections.

ALBERGER CONDENSERS FOR LONDON.—The Alberger Condenser Company, 95 Liberty Street, New York, have secured the contract for the condensing equipment for the Neasden, London, N.W., power station of the Metropolitan District Railway. The equipment will be a high-vacuum one and of a similar type to the Alberger equipment to be installed in the New York Rapid Transit power station. The Neasden contract calls for three 3,500-kw. outfits for turbine use. The contract for the entire equipment of the plant was awarded some time ago to the British Westinghouse Electric & Manufacturing Company, Limited.

PELTON WATER WHEELS FOR SPAIN.—The Pelton Water Wheel Company, New York offices, 143 Liberty Street, is about to make shipment to Spain of a 2,500-h.p. plant for the purpose of operating a cement factory now under construction in the vicinity of Barcelona. The entire factory will be furnished with American equipment. There will be 10 Pelton wheels, varying from 24-in. to 96-in. in diameter. The contract also calls for the shipment of three miles of steel riveted pipe, 25 in., 28 in. and 31 in. in diameter. The Pelton people have also recently received a number of fair sized Mexican orders for water wheels and pipe.

EQUIPMENT FOR BRITISH WORKS.—E. W. Buckley, works superintendent of the British engineering firm of Mather & Platt, Limited, one of the most prominent concerns of its kind in Europe, is now in the United States for the purpose of purchasing a considerable quantity of American equipment, etc. The firm manufactures engines, dynamos, etc., on an extensive scale. Mr. Buckley at time of writing was in Pittsburg at the Queens Hotel, but is expected in New York during the early part of next week. While in New York he will be at the Holland House.

AMERICAN EQUIPMENT FOR SWEDISH GRANITE QUARRIES.—The Halmstads Stenhuggen Aktiebolag, of Halmstad, which operates some of the largest quarries in Sweden, is about to place contracts for considerable Yankee equipment as a result of the recent visit to this country of Otto Petersen, the manager. The quarries are to be operated by current generated by water power located near by. The machinery from this side will include cableways, pumps, hoists and derricks, etc.

LARGEST INTERLOCKING INSTALLATION.—A contract for the largest interlocking installation ever placed in America, and probably much the largest in the world, has recently been given to the Union Switch & Signal Company for the St. Louis Terminal. The Westinghouse electro-pneumatic system will be adopted, and the contract calls for 258 working levers, with 51 spare levers, which will perform 748 functions.

BOSTON ELECTRIC ROADS.—The *Boston Advertiser* says it now looks as if all plans for the electrical operation of steam roads between Boston and the suburbs will be abandoned. The reasons given are the high price of coal, the continued agitation for lower fares and the threat of strikes. The advance in wages on the systems running into Boston will amount to something like $2,000,000 a year.

SCHENECTADY TROLLEY.—The Schenectady (N. Y.) Railway Company has authorized an issue of $7,000,000 additional bonds to extend lines to Amsterdam and other points for improvements. The bonds are 4½ per cent. 50-year bonds. They will be issued on a basis of 75 per cent. of the actual cost of improvements.

THE GLASGOW (SCOTLAND) CORPORATION, which is a municipal concern, has contracted with the British Westinghouse Electric & Manufacturing Company, Limited, for the electric motor equipment of 100 cars, costing approximately $87,645.

CINCINNATI LIGHTING.—Stockholders of the Cincinnati Gas & Electric Company, at their annual meeting on May 4 will act on a proposition to increase the company's capital $1,000,000 for improvements.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—Application has been made to the Board of Supervisors by the Pomona Valley Telephone and Telegraph Company for a permit to erect the poles necessary for ten to twenty miles of telephone line between Claremont, Spadra and other points in the Pomona Valley.

PAYETTE, IDAHO.—The town council has granted a franchise to Ruben E. Shaw and associates to establish a telephone system.

PRESTON, IDAHO.—Articles of incorporation of the Oneida Telephone Company, with headquarters at Preston, have been filed at Boise.

PAYETTE, IDAHO.—The Payette Valley Telephone Company has filed incorporation papers. The company, which is incorporated for $40,000, will build a telephone system in New Plymouth, Idaho.

METAMORA, ILL.—The Metamora Telephone Company has increased its capital stock from $280 to $12,000.

ROCKFORD, ILL.—The Winnebago County Telephone Company has increased its capital stock from $5,000 to $25,000.

CARLYLE, ILL.—Geo. Johnpeter, of Posey, has been granted a franchise to build a telephone line between Bartelso and Carlyle.

CHICAGO, ILL.—The Woodlawn Park Telephone Company is asking for a franchise in Woodlawn. The council committee has recommended its passage.

BLOOMINGTON, IND.—The Stouts Creek Telephone Company has been incorporated by Samuel Hunter, John A. Parks and Joseph World.

INDIANAPOLIS, IND.—The Farmers' Accommodation Telephone Company, of Greene township, Hancock County, has been incorporated.

WATERLOO, IND.—An independent telephone company has asked for a franchise to operate a telephone exchange and toll lines in this city.

BICKNELL, IND.—The Bicknell Telephone Company has incorporated with a capital stock of $6,000. J. H. Barr is president and John S. Hoover, secretary.

CARLISLE, IND.—The Carlisle Co-operative Telephone Company has incorporated. The capital is $10,000. John Wipps and Charles Griffin are directors.

GREENFIELD, IND.—The Star Line Telephone Company, of Hancock County, and the Banner Telephone Company, of Greenfield, have been incorporated.

INDIANAPOLIS, IND.—The Amboy Home Telephone Company has been incorporated with a capital stock of $5,000, by W. H. Miller, W. H. Houch, Robert Ridgeway, E. F. Cox and John Stancomb.

GARRETT, IND.—The Garrett Telephone Company has been incorporated with a capital stock of $15,000, by John B. Mager, S. B. McCullough, James M. Ritter, W. H. Coffinsberry and H. W. Montz.

DEER CREEK, IND.—A. A. Cook is at the head of a co-operative telephone company that is to establish an exchange in this village. He has already eighty subscribers, and the equipment is to be purchased soon.

INDIANAPOLIS, IND.—The Landesville Rural Telephone Company, of Grant and Huntington Counties, has been incorporated with a capital stock of $4,200, by Henry Wine, Rude Freeman, Simon Clevenger and Wade Robinson.

ORANGE, IND.—The Orange Mutual Telephone Company, capitalized at $3,500, has been incorporated. It will build a line in Fayette County. The incorporators are W. F. Schrontz, W. P. Sipe, W. R. Conaway, George A. Looney and J. E. McKee.

RICHMOND, IND.—The Richmond Home Telephone Company's business has so far exceeded expectations that the capacity of the plant is found wholly insufficient. Eighteen hundred telephones are in use, and the plant will be increased, so as to give service to nearly as many more subscribers.

NEW CASTLE, IND.—The Sulphur Springs Co-operative Telephone Company has been incorporated. It is composed of 12 separate systems in Jefferson, Fall Creek and Harrison townships. The central station will be at Sulphur Springs. The directors are Strod Hayes, Rufus Mann, David F. Hoover, Henry Fadely, Joseph Williams, J. Huffman, Asa Maddy, John McSherley and George Fleming.

INDIANAPOLIS, IND.—The directors of the New Telephone Company have elected officers as follows: S. P. Sheerin, president and general manager; Louis Holweg, vice-president, and H. B. Sale, secretary. The annual report shows that the company had on the first day of March, 6,716 telephones, which is an increase of 1,781 during the year. The gross receipts for the year were $180,471, being an increase over the previous year of nearly $40,000.

DES MOINES, IA.—The Iowa Telephone Company plans to lay down a large amount of conduit during the present season.

COUNCIL BLUFFS, IA.—The Western Iowa Independent Telephone, Telegraph & Terminal Company has been incorporated with a capital stock of $40,000.

GRANBY, MASS.—The Granby Telephone & Telegraph Company has been incorporated with a capital stock of $1,200. Mr. Willard A. Taylor is president, and Richard E. Dickson, treasurer.

FAYETTE, MO.—A. F. Davis, president of the Fayette Telephone Exchange, has bought the Glasgow Telephone Exchange from Wicks & Peters for $9,000. This gives the Fayette Telephone Company full control of all the independent lines in Howard County.

ALBANY, N. Y.—The New York and Long Island Telephone Company (to operate in Kings, Queens, Nassau and Suffolk counties), has been incorporated; capital, $100,000. Directors: W. H. Bennett, G. L. Deneo and B. P. Tabbot, New York.

ALBANY, N. Y.—The West Chazy & Sciota Telephone Company has been incorporated to build a line between West Chazy and Sciota. The capital is $700 and the directors are W. McGaulley, W. E. Clough and F. N. Swift, of West Chazy.

SPRAY, N. C.—The International Telephone Company, of Spray, has been chartered with $125,000 authorized capital. The company has the right to construct telephone lines and to build an interurban electric railway.

TROY, OHIO.—Council of Pleasant Hill has granted to the Covington Telephone Company a franchise for a local exchange.

COLERAIN, OHIO.—The Colerain Telephone Company has increased its capital stock to $10,000, and will make improvements. D. A. Bevis is president.

STEUBENVILLE, OHIO.—The Farmers' Independent Telephone Company, of Smithfield, will build a line through New Alexandria to Mingo Junction.

STEUBENVILLE, OHIO.—The Scroggsfield Telephone Company has completed a line to Carrollton and now gives service in seven towns in this county.

WESTWOOD, OHIO.—The City & Suburban Telephone Association (Bell) will build a branch exchange at Westwood to supply the surrounding villages at rates now prevailing in Cincinnati.

BUCYRUS, OHIO.—The Bucyrus Telephone Company is planning to improve its exchange and is investigating the merits of several leading makes of switchboards before making a selection.

ATTICA, OHIO.—The Farmers' Mutual Telephone Company has been organized for the purpose of constructing telephone systems in Seneca, Huron and Wyandotte counties. J. W. Walker is president and J. Zellers, secretary.

MARYSVILLE, OHIO.—The Marysville Telephone Company will be incorporated and a re-organization of the present telephone system owned by N. E. Liggitt will be effected. A number of improvements and extensions will be made.

MARIETTA, OHIO.—The Muskingum Valley Telephone Company has decided to make a number of improvements. Exchanges will be built at Beverley and Lowell and lines will be built to McConnelsville by way of Stockwell, Coal Run and Lowell.

VAN WERT, OHIO.—The Van Wert Telephone Company is planning to make important improvements. A mile of cable will be strung in the city and an addition to the switchboard will be installed. A line will be built to Shanesville to connect a large number of farmers.

NEW BENTON, OHIO.—A company is being organized to build telephone lines throughout Deerfield, Berlin Center and Diamond, and the promoters are figuring on supplies. The system will be connected with the lines of the United States Telephone Company. Dr. E. Miller is the chief promotor.

TOLEDO, OHIO.—At the recent annual meeting of the Toledo Home Telephone Company all the present directors were re-elected, with the exception of General C. M. Spitzer, whose place was filled by Clarence Brown. A proposition to spend $30,000 in laying new cable and extending the switchboard was favorably acted upon.

TONKAWA, OKLA.—The Farmers' Mutual Telephone Company has been organized at Owens to build a system between Tonkawa and Billings, a distance of 21 miles.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company now has 11,000 telephones connected. During the year connections have been established with Oil City, Pa., Warren and Wellsville, Ohio, and many other important points.

TITUSVILLE, PA.—The Petroleum Telephone Company, operating lines touching Oil City, Franklin, Titusville and other places, has, it is reported, passed into the hands of a receiver. The company was started two years ago in competition with the Bell Company.

PHILADELPHIA, PA.—The Keystone Telephone Company will build a trunk line between Philadelphia and Morrisville to connect with the Interstate Telephone Company, of Trenton. The company also intends to rebuild its line between Trenton and Camden, thus providing another route to Philadelphia.

CRESSON, PA.—The Cambria County Telegraph & Telephone Company will expend during the Spring $25,000 in improvements to its system. New lines will be built to Altoona giving direct and independent connections with the lines of the Central Telephone Company and through them with Harrisburg, Philadelphia and Pittsburg.

SALT LAKE CITY, UTAH.—The Bell Telephone Company in this city intends to place all the telephone wires in the business section of the city under ground this year.

MARTINSBURG, W. VA.—A controlling interest in the Berkeley Springs Telephone Company has been bought by John J. Hetzel, who represents a syndicate. The company will extend its lines throughout Morgan County and reach outside points through the system of the Winchester Telephone Company.

PARK FALLS, WIS.—The Park Falls Telephone Company has been granted a franchise for a local and long-distance telephone system in and between Park Falls, Phillips and Mellen.

FORT WILLIAM, ONT.—The Municipal Telephone Exchange was destroyed by fire recently, entailing a loss of $6,000. The property was fully insured. A new exchange will be built at once.

MONTREAL, QUE.—A deal has been completed by which the Merchants' Telephone Company, of Montreal, has passed under the control of a New York syndicate. Mr. Arthur Johns, of New York, represented the syndicate in the deal. The total common stock of this company amounts to $61,000, and in addition to this, there is a bond issue of about $60,000, secured on first mortgage and paying eight per cent. interest. No dividend has been paid on the common stock.

ELECTRIC LIGHT AND POWER.

COEUR D' ALENE, IDAHO.—The Cable Milling Company will construct an electric light plant and water works, at a cost of $40,000. It will probably be ready for bids in 30 days. Mr. B. O. Graham is secretary.

KEWANEE, ILL.—It is stated that the Kewanee Light & Power Company will install a plant, at a cost of about $40,000.

EVANSTON, ILL.—The Evanston Yaryan Company has been ordered by the court to pay $260,989.45, the interest on its outstanding bonds. In default of payment the plant is ordered sold by Master in Chancery Elting.

PAXTON, ILL.—The Paxton Light, Heat & Power Company has been incorporated, with a capital of $150,000, to deal in light and power. Incorporators: J. B. Richardson, H. Walter Bond and Gerald A. Griffin.

RANTOUL, ILL.—The Rantoul Water, Light & Power Company, of Rantoul, has been incorporated, with a capital of $2,500, to erect and maintain water works, heat, light and power plants. Incorporators: Geo. P. Heckel, Thos. J. Roth and John D. Neal.

WINONA, IND.—Contracts have been let for the construction of a new electric light and heating and pumping plant here, to cost $125,000.

ANDERSON, IND.—It is stated that the Union Traction Company, of Indiana, contemplates going into the electric light business and will soon apply for franchises along its line.

RICHMOND, IND.—The city council has refused the proposition of capitalists to purchase the municipal electric lighting plant and has ordered electrical equipments for immediate delivery as follows: General Electric Company, $1,430 and $1,320; Monarch Electrical Company, $550; Westinghouse Electric & Mfg. Company (October delivery), $4,100; total value of new machinery ordered, $7,405. The present value of the plant is placed at $166,120. The plant made a better showing for February. The receipts were $950 in excess of the expenses. Heretofore the plant was operated at a loss each month.

HUMESTON, IA.—Jas. L. Humphrey is interested in the construction of an electric light plant here.

COVINGTON, KY.—The Stewart Iron Works Company will equip a large new factory with electric drive throughout.

ELLSWORTH, ME.—The Bar Harbor & Ellsworth Light, Gas & Power Company is stated to have secured options on Union River dam properties. This company will continue the electric lighting in Ellsworth and Bar Harbor and will probably extend to Northeast Harbor and Seal Harbor.

TOLLARD, MASS.—The G. L. Straw Co., of Boston, is reported interested in the construction of a power plant on Farmington River, between Tollard and Sandisfield.

COLD SPRING, MASS.—F. G. Smith and F. D. Gilligan, of New York, N. Y., it is stated, have secured water privileges at Cold Spring on Farmington River and will build a plant for the generation of electricity.

MAYVILLE, MICH.—The citizens have voted to issue $5,000 electric light bonds.

BANGOR, MICH.—The citizens have voted to issue $25,000 electric light and water bonds.

PLYMOUTH, MICH.—It was voted March 9 to issue $12,500 bonds for the construction of an electric light plant. E. Gayde is village clerk.

ALLEGAN, MICH.—It was voted on March 9 to issue $30,000 bonds for the purchase of the electric lighting equipment now rented and improving the water works and water power. C. F. Davison is village clerk.

MORRIS, MINN.—The council is considering the question of establishing a lighting plant.

WINONA, MINN.—The Winona Railway & Light Company will expend about $100,000 in improvements, including the purcahse of motors, an engine, a condenser, new arc lights, etc.

MANKATO, MINN.—Bids are being received for an electric light plant, to cost about $40,000. Separate bids are required for the boilers. J. R. Thompson is city manager.

EXCELSIOR SPRINGS, MO.—W. A. Bell, of Denver, Colo., is reported to have purchased the electric light plant and water works, and will expend about $70,000 in improvements.

MEXICO, MO.—The City Council has been appointed a committee to correspond with manufacturers in regard to having a gas and electric light plant built here, giving a franchise in exchange for street lighting.

VIRGINIA CITY, MONT.—The Bismark-Nugget Gulch Consolidated Mining Company has, it is reported, secured a franchise for an electric light and power plant on Mill Creek.

BENEDICT, NEB.—W. G. Keeler has purchased the electric light plant and will remodel it.

GREENVILLE, N. H.—A committee has been appointed to investigate the question of constructing an electric light plant.

MANCHESTER, N. H.—A committee has been appointed to report on the feasability of a municipal lighting plant. Sam'l J. Lord is city engineer.

MANCHESTER, N. Y.—On March 17 it was voted to construct an electric light plant. A. Dunham is village clerk.

AKRON, N. Y.—It was voted on March 17 to issue $10,000 bonds to establish an electric light plant. E. E. Stratton is village clerk.

FAR ROCKAWAY, L. I., N. Y.—The Queens Borough Electric Light & Power Company has filed plans for a power house to be located on Clinton Street, to cost $25,000.

GREENE, N. Y.—The citizens have voted bonds to the amount of $13,000 for the construction of an electric light plant and $2,500 to purchase the local electric plant, to use until the new plant is completed.

ST. REGIS FALLS, N. Y.—The St. Regis Light & Power Company has been incorporated at Albany with a capital stock of $50,000. The directors are W. T. O'Neil, H. E. O'Neil and W. B. Babcock, of St. Regis Falls.

ROUSE'S POINT, N. Y.—The town of Rouse's Point has lately adopted three-glower Nernst lamps for street lighting, and the completing of the installation was made the occasion for a local demonstration with the usual brass band adjuncts.

ASHEVILLE, N. C.—Ladshaw & Ladshaw, of Spartansburg, S. C., have made a survey of an undeveloped water power on the French Broad River near Asheville, which may be developed electrically.

MURPHY, N. C.—Capt. Alfred Emerson and others will organize the Cherokee Power & Lighting Company to develop the water power of Hiawassee River, near Murphy, and transmit the same to nearby points.

CHARLOTTE, N. C.—B. S. Drake, of the U. S. Geological Survey, has been detailed to make a survey of certain water courses in South Carolina where he thinks enough power is available to operate every industry in the State.

NEW ROCKFORD, N. D.—The Light, Water & Improvement Company has been formed to put in a lighting plant.

SANDUSKY, OHIO.—The Cedar Point Pleasure Resort Company will install a power plant at Cedar Point.

WESTON, ORE.—The City Council has appointed a committee to investigate the feasibility of obtaining power for an electric light plant from Umatilla River.

EUGENE, ORE.—The Lane County Electric Company has been incorporated, with a capital of $100,000, by D. A. Paine, J. F. Robinson and others. This company absorbs the Eugene Electric Light Company and proposes establishing an electric plant at Springfield to generate electricity to supply light for Springfield and Eugene.

OAKMONT, PA.—The entire plant of the Oakmont & Verona Light, Heat & Power Company was destroyed by fire March 13.

POTTSTOWN, PA.—It is stated that a 300-hp engine and two generators will be added to the equipment of the Pottstown Light & Power Company.

WAYNE, PA.—The Haverford Electric Light Company and the Wayne Electric Light Company, both owned by the United Gas Improvement Company, will be merged and the villages in Lower Merion Township will all soon be lighted by electricity from the Wayne plant, which will be enlarged.

YORK, PA.—The York Haven Electric Power Company's plant, now in course of construction, has a sub-station in Manchester township all ready. Machinery will be installed in a short time. The current will be transmitted from the York Haven plant some time in September when the above-named plant is completed.

PELZER, S. C.—It is rumored that the Pelzer Manufacturing Company may develop a fine water power on Salinda River. An interurban trolley line is also spoken of.

MEMPHIS, TENN.—The Memphis Consolidated Gas and Electric Company has filed an abstract of its charter which provides for a merger of the Memphis Light and Power Company and the Equitable Gas Light Company. The authorized capital is $4,000,000. New York and Chicago capital is interested.

KNOXVILLE, TENN.—A party of English and Eastern capitalists have visited Knoxville in the interests of the proposed Knoxville Power Company, whose purpose is to develop Little Tennessee River, 35 miles from Knoxville, where 20,000 horse power is available. A number of contracts have been signed by Atlanta manufacturesr for electric power.

CALDWELL, TEX.—Wallin & Scott have decided to construct an electric light plant.

JACKSONVILLE, TEX.—The Jacksonville Electric Company, of Jacksonville, has been incorporated with a capital of $20,000. The incorporators are J. D. Gibbs, R. T. Gibbs and J. C. Braschear.

CENTER POINT, TEX.—The Center Point Electric Light, Power & Irrigation Company, of Center Point, has been incorporated; capital, $6,000. Incorporators: H. Nail, Jas. Sellers and Jas. Crotty.

VERNAL, UTAH.—F. M. Benedict, of Salt Lake, Utah, has been granted a franchise to put in an electric light plant at Vernal.

PETERSBURG, VA.—The Virginia Passenger & Power Co., it is stated, has secured the contract for furnishing the city with electric lights of 2,000-cp. for one year at $57 per light per year.

SEATTLE, WASH.—An ordinance has been introduced in Council providing for the issue of $590,000 bonds for a municipal electric light plant.

CEREDO, W. VA.—The Ceredo Water & Light Company has been incorporated with a capital of $20,000. Incorporators: Louis Prichard, W. F. Burns and others, of Ceredo.

SUN PRAIRIE, WIS.—Dr. L. V. Lewis and Prof. Jas. Meville have been appointed to investigate the matter of a municipal electric plant.

MIDLAND, ONT.—The town of Midland has adopted a by-law to take over the electric light system of the town. The sum voted is $20,000, of which $9,000 is for the purchase of the present company's plant, and the balance for extensive improvements and additions to the system. By this step the town completes its ownership of municipal franchises, and with its waterworks and docks will have a very complete municipal outfit.

WINNIPEG, MAN.—The Great Falls Power Company has submitted a proposal to the city to deliver 3000 horse-power of electrical energy in the city on condition that the city grants it a franchise for a period of 15 years. It proposes to charge $50 per horse-power per annum. It is stated that it is the intention of the company to develop ultimately 40,000 horse-power at Great Falls on the Winnipeg River, at an outlay of from $2,000,000 to $7,000,000. Mr. Samuel Insull, of Chicago, is president of the company, the vice-president being Mr. Robert T. Lincoln.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—The Los Angeles Railway Company has awarded the Electric Storage Battery Company, of Philadelphia, a contract for a storage battery installation, involving about $250,000.

SAN MATEO, CAL.—The South San Francisco Railroad & Power Company has been incorporated to build 13½ miles of electric road in South San Francisco and San Mateo, for $100,000. William J. Martin, secretary of the South San Francisco Land Company, is interested.

LOS ANGELES, CAL.—Applications have been presented to the city council by different interests asking for street railway franchises for about twenty miles more of street railway. The Los Angeles Railway Company, the Los Angeles Traction Company and private individuals are the applicants.

LOS ANGELES, CAL.—The Clear Lake Electric Railway and Power Company has incorporated to do business in Lake County and is heavily backed by Los Angeles capital. A road about 40 miles long will be run between Cloverdale and Lakeport, tapping a section of country that has never had a railway. The capital stock is $1,000,000. Dr. W. R. Prather, of this city, is one of the principal stockholders.

DENVER, COLO.—The Denver & Northwestern Railroad, which owns the Denver Tramway, is about to let contracts for building an electric railway to be operated in connection with the Denver Tramway, from Denver to Golden, and from Denver to Boulder. The line to Golden will be about 10 miles, and to Boulder about 22 miles. The formal incorporation of the two new roads will shortly be made.

MERIDEN, CONN.—It is announced that a third-rail electric service will be established between Meriden and Middletown by the New York, New Haven & Hartford Railroad. The Meriden Division, which runs from Waterbury to Middletown, will be electrically equipped between this city and Middletown soon, so it is said, and it is expected a third-rail servce will also be established between Meriden and Waterbury.

NEW HAVEN, CONN.—The most important railroad fight in the recent history of Connecticut is on before the Joint Judiciary Committee of the State Legislature, in regard to the proposed repeal of the present general railroad law. All the railroad interests of the State have been represented at the committee sessions, besides scores of outside interests. The struggle, however, is between the resident steam and trolley interests of the State and the proposed Boston to New York third-rail line parallel to the Consolidated road. Under the present railroad laws the company which plans the third-rail line has the right to condemn land and build its road. Demanding repeal of this law appear representatives of the Consolidated road, the majority of the street railroads, and the Connecticut Lighting and Railway Company, agent of the Philadelphia United Gas Improvement Company. Against it appear the Connecticut representatives of James F. Shaw & Co. and Gay & Co., bankers, of Boston, who are financing the new line; the old Connecticut Western extension people, and the Vermont Central Railroad.

WASHINGTON, D. C.—The President has before him for approval an ordinance granting to the Vandergrift Company, a Philadelphia organization, a right-of-way for an electric railway across the island of Porto Rico. The road will be 80 miles in length and will connect San Juan with Ponce. The plans call for a large power plant which will supply power to manufacturing concerns on the island and act as a feeder for short electric railways along the coast of the island.

ATLANTA, GA.—Application has been made for a charter for the Piedmont Electric Railway Company, which is to build an electric railway to Roswell and from Roswell. The capital stock will be $500,000. The incorporators named are E. S. Brakelton, of Birmington, Ala.; Charles S. Kingsbery, E. C. Akins, T. J. Hightower, C. W. Hunnicutt, John T. Stocks, H. L. Hunter, B. F. Curtis, Charles K. Maddox, F. M. Stocks, Thomas F. Stocks, R. E. Bondurant, J. A. Tiller and John Burnett, of Atlanta.

GALESBURG, ILL.—The Galesburg & Aledo Interurban Railway Company is to be incorporated to build the projected electric railway between Galesburg and Aledo. The officers of the company are: L. W. Sanborn, of Galesburg, president; C. L. Gerould, of Galesburg, secretary and treasurer; J. J. Welsh, of Galesburg, attorney; A. L. Richey, of Galesburg, engineer.

MOLINE, ILL.—The Illinois Electric Railway Company has been incorporated to construct an electric railway to connect Galesburg, Monmouth, Aledo, Moline, Rock Island and Macomb. The amount of the capital stock is $10,000. The incorporators and members of the first board of directors are John S. Brown, I. M. Kirkpatrick and William H. Sexton, of Monmouth, Ill.; Robert P. McGeehan, of Kansas City, Mo., and James E. Gregg, of Colorado.

GREEN CASTLE, IND.—A franchise has been granted to Messrs. Benson & Holstead, of Brazil, to operate an electric railway in this city.

BRAZIL, IND.—Local capitalists have projected an electric railway to connect this city with Cordonia, Benwood, Carbon and Diamond, all mining towns.

LAFAYETTE, IND.—The Fountain and Warren Traction Company, which proposes to build a line from Danville, Ill., through Covington, Ind., to this city, has filed a written acceptance of the franchise granted by the City Council to enter this city.

VINCENNES, IND.—It is said that the proposed interurban electric railway from Vincennes to Jasper, Ind., is to be extended from Jasper to Rockport, Ind., and thence to Owensboro, Ky., and that the Union Trust Company, of New York, will finance the company which will have a capital of $2,000,000.

MARION, IND.—At a recent meeting of the directors of the newly incorporated Northern Indiana Traction Company the following officers were elected: R. E. Breed, Marion, president; B. F. Burk, Marion, vice-president; G. A. H. Shideler, Marion, secretary-treasurer; E. H. Neal, Jonesboro, general agent; H. F. Coleman, New York, general manager; George Breed, Philadelphia, consulting engineer.

FT. WAYNE, IND.—A company has been organized in Philadelphia to buy the Ft. Wayne Traction Company. It is officered as follows: President, George F. McCulloch; vice-president, J. Levering Jones, Philadelphia; second vice-president, James Murdock, Lafayette; secretary, S. B. Fleming, Ft. Wayne; Hugh McGown, Randall Morgan, Charles Murdock and Bayard Henry constitute the board of directors. The price paid is said to be over $1,600,000. The capital of the new company will be $5,000,000, and it is given out that the deal is the forerunner of a combination of the Ft. Wayne & Southwestern Interurban, the Wabash Valley, the Lima and Ft. Wayne and McCulloch-Murdock systems in Indiana.

MACHIAS, ME.—The Lumberman's Electric Railway Company is seeking incorporation. The plan is to connect Machias, Machiasport, East Machias and Jonesboro. E. B. Curtis, E. P. Grimes and S. N. Fahey are interested.

FAIRFIELD, ME.—The Fairfield & Shawmut Railway Company, which has in contemplation the construction of an electric railway from Fairfield to Shawmut, has perfected its organization, electing the following officers: Amos F. Gerald, president; William T. Haines, treasurer; Harvey D. Eaton, clerk; Amos F. Gerald, William T. Haines and George Fred Terry, directors.

WORCESTER, MASS.—The Hartford & Worcester Street Railway Company has been granted its charter. The capital stock authorized is $300,000. The charter permits the company to build a line from Worcester to the Connecticut State line in the town of Wales, a distance of 30 miles.

LEWISTON, MONT.—The Citizens' Electric Company has under consideration a plan to build an electric railway from Lewiston to Kendall. J. L. Bright is president of the company.

LINCOLN, NEB.—The Omaha, Lincoln & Beatrice Railway Company has been incorporated, with a capital stock of $2,000,000, to build an electric railway to connect Omaha, Lincoln and Beatrice. The incorporators of the company are: Elbert C. Hurd, Henry H. Wilson, Elmer W. Brown, William R. Shankland and Charles D. Biggerstaff.

HORNELLSVILLE, N. Y.—The Allegheny Electric Construction Company has been organized, with a capital stock of $150,000, to build an electric railway in Hornellsville, Alfred and Almond.

SALAMANCA, N. Y.—The Ellicottville, Mansfield & East Otto Railway Company has been organized to build an electric railway from Ellicottville to East Otto. The capital stock is $250,000 and the stockholders include Hon. A. B. Fancher, of Salamanca, and John S. Rockwell, of Buffalo.

UTICA, N. Y.—A special meeting of the stockholders of the Utica & Mohawk Valley Railway Company was held April 1, for the purpose of voting on a proposition to increase the capital stock of the company from $3,100,000 to $6,250,000. The increase, it is stated, is for improvements to the system.

ITHACA, N. Y.—The Auburn-Ithaca Railroad Company is about to incorporate. The company is said to have perfected all the preliminary arrangements for building its proposed line between Ithaca and Auburn. The present officers of the company are: Isaac P. Hazard, president; Dexter Wheeler, vice-president; Sherman Collins, secretary; E. B. Mosher, treasurer.

GOSHEN, N. Y.—The Intervale Traction Company, incorporated last summer, has arranged for a survey of its proposed line between Goshen and Newburgh. The officers of the company are: Edward R. Emerson, of New York, president; Hiram B. Odell, of Newburgh, vice-president; W. J. McKay, of Newburgh, secretary; Lewis W. Stotesbury, of New York, treasurer.

FAYETTEVILLE, N. C.—H. L. Clark and others are interested in the securing of a street railway franchise at Fayetteville.

TOLEDO, OHIO.—The Toledo Urban & Interurban Railway Company, capitalized at $100,000, has been incorporated.

CHAMBERSBURG, PA.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company will increase its capital from $120,000 to $300,000.

JOHNSTOWN, PA.—The Johnstown & Scalp Level Street Railway Company, capitalized at $42,000, has been chartered at Harrisburg. The directors are: Joseph Ruth, president; Gernard Nees, Charles J. Hoffman, Jacob Grosch and Conrad Nees.

LANCASTER, PA.—The Tennis Construction Company, of Philadelphia, has been awarded the contract by the Lancaster, Millersvile & York Furnace Railroad Company for the building of the company's new road from Millersville to York Furnace via Pequea.

NASHVILLE, TENN.—The Nashville Railway Company which has been in the hands of a receiver for two years will be sold by order of the courts within 40 days. It is believed that Newmans, banker, of New York and New Orleans, will purchase the property.

AUSTIN, TEX.—The Austin Electric Railway Company has filed an amendment to its charter, increasing its capital from $200,000 to $350,000.

GRANBURY, TEX.—The Granbury & Glenrose Traction Company has been organized to build an electric railway between Granbury and Glenrose. G. W. Landers and D. O. Baker, of Granbury, and G. F. Gaither and T. J. Bryan, of Glenrose, are interested.

TEXARKANA, TEX.—The Texarkana Light & Traction Company has been incorporated, with a capital stock of $200,000. The officers of the company are: E. J. Spencer, president; M. C. Wade, vice-president; W. H. Arnold, secretary; E. K. Smith, treasurer.

GRAFTON, W. VA.—Humphrey Brohard, of Flemington, will apply for a franchise to construct an electric railway through the county.

PARKERSBURG, W. VA.—The Pickens & Addison Railway Company has been incorporated, capital $5,000. Incorporators: E. A. Beckley, R. L. Walkley, of New Haven, Conn.; W. E. Douglas, of Jefferson, Ohio; F. O. Havener, of Parkersburg, W. Va.; J. F. Johnson, of Pickens, W. Va.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company has increased its capital stock from $20,000 to $750,000.

NEW INDUSTRIAL COMPANIES.

THE TWIN MOTOR VEHICLE COMPANY has been organized at Scranton, Pa., to manufacture motor vehicles of all kinds. The capital is $100,000.

THE BALLOU ELECTRO-DEPOSIT COMPANY, with a capital stock of $300,000, has been incorporated in New Jersey by H. V. Vandenberg, W. L. Ballou and Warren Dixon.

THE CHIAPON CONSTRUCTION COMPANY, of Chicago, has been incorporated under the laws of Delaware to operate and maintain telegraph and telephone lines. The capital stock is $100,000.

THE NEW YORK ELECTRIC MAINTENANCE COMPANY has been incorporated with a capital stock of $25,000. The directors are H. D. Davy, Helmuth Moerchen and A. P. Nevin, of New York.

THE BRODE ELECTRIC COMPANY, with principal place of business in Los Angeles, Cal., has incorporated; capital stock, $50,000. Directors: Luther D. Brode, J. F. Conroy, A. W. Brode, S. A. Jackson and W. H. O'Bryan.

THE INDEPENDENT GAS AND ELECTRIC COMPANY, principal place of business Los Angeles, Cal., has been incorporated; capital stock, $200,000. The directors are H. C. Rogers, F. G. Walsh, E. M. Durant, F. M. Porter and M. A. Newkirk.

THE AMERICAN DISTRICT TELEGRAPH COMPANY has been organized in Phoenix, Ariz., with a capital stock of $300,000. The directors are H. E. Bennett, G. R. Johnston, Frank Jaynes, F. H. Lamb and Henry Bostwick, of Arizona.

HEGENER ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000. The incorporators are James F. Beranek, Frank C. Hegener, Jesse F. Litchen, Herbert F. Weeman, Sarah Ann Beranek.

THE ELECTRIC POWER COMPANY has been incorporated at Keosauqua, Ia., with a capital of $10,000, to construct a canal for power purposes and construct and operate power plants. Capt. W. A. Duckworth, president; E. L. McCoid, secretary.

THE COOLEY EPICYCLOIDAL ENGINE COMPANY has been incorporated at Trenton, N. J., with a capital stock of $10,000,000, to manufacture engines. The names of the incorporators are Charles S. Farquhar, Edward A. Pheppen, George F. Taft, D. W. Farquhar, Henry W. Longfellow, John T. Cooley and William C. Gray, all of Boston, and Matthew E. Gately, of Waltham, Mass.

THE COLUMBIA ELECTRIC COMPANY, of Indianapolis, has incorporated with a capital stock of $50,000. The company proposes to manufacture and sell telephones and other electrical appliances and to build, own and operate electrical plants and install machinery, etc. The company's plant and office will be located in Indianapolis. Seymour Mansor, F. N. Martindale, Luther R. Frost are the incorporators.

LEGAL.

ELECTRICAL ASSESSMENTS.—A temporary injunction has been issued restraining the City of Cleveland from increasing largely the assessment on electric railway and lighting companies in that city.

SHOCK THROUGH WATER.—A unique case has just been closed in Los Angeles County, Cal., wherein a verdict of $5,000 damages was awarded to one Lyman Newton. Newton was a watchman in the plant of the United Electric, Gas & Power Company, at Long Beach, Cal. He threw a bucket of water on an incipient fire which was caused by crossing of wires, and claimed that the water formed a conducting column through which he received a shock, thus crippling him for life.

CUTLER-HAMMER RHEOSTAT DECISION.—Judge Kohlsaat, of the United States Circuit Court at Chicago, rendered a decision March 26 in the case of the Cutler-Hammer Manufacturing Company against Hammer et al, sustaining the Blades patent owned by the Cutler-Hammer Manufacturing Company. This patent covers the automatic magnetic release used on hand-operated rheostats, for allowing the rheostat handle to return to "off" position in case the circuit is interrupted. The suit has been bitterly fought for the past three years. The patent had previously been held invalid by Judge Baker, of the United States Circuit Court of Indiana. Judge Kohlsaat refuses to follow Judge Baker's decision, and holds the patent to be valid. The Cutler-Hammer Manufacturing Company was represented by Jones & Addington, of Chicago. The defense was made by the General Incandescent Arc Light Company, represented by Donald M. Carter.

OBITUARY.

MR. JOSEPH KAVANAGH.—The many friends of Mr. Joseph Kavanagh, the genial and popular assistant treasurer of the New York Telephone Company, were grieved to learn of his death on Thursday, March 26, in this city. Mr. Kavanagh had been ailing for some months from pulmonary complaints, but favorable reports of his condition had been received, and it was supposed that he would shortly be able again to take his place among his business associates. He was born in January, 1860. The beginning of Mr. Kavanagh's business career was contemporary with the introduction of the telephone as a factor in commercial life, and it was in the treasurer's office of the Bell Telephone Company, of New York, in the fall of 1879, that he held his first position as clerk. His friendliness and tact, no less than his industry and ability, marked him for promotion, and in 1890 he was made assistant treasurer of The Metropolitan Telephone & Telegraph Co., then operating the Bell telephone patents in this city and vicinity. Upon the dissolution of The Metropolitan Co., in 1896, he was elected to the office of assistant treasurer of its successor, the present New York Telephone Co. He was also treasurer of the North Jersey and East Jersey Telephone & Telegraph companies. While a valued officer of his company and ranking high in the opinion of the foremost men in his business, Mr. Kavanagh was loved by the men over whom he was placed and was served with devoted loyalty. His personality will long be held in affectionate remembrance by all who knew his wholesouled and generous character. His wife and four children survive him. His wife is a daughter of the late Amzi S. Dodd, well known as an organizer in the telephone field. The funeral services were conducted on March 29 at Long Branch, N. J., in the Star of the Sea Church, Father William P. Cantwell officiating. The floral tributes were numerous. A special train from New York took about 300 officers and employees of companies in which Mr. Kavanagh was interested. The honorary pall bearers were Charles F. Cutler, President of the New York Telephone Company. William H. Woolverton, President of the New York Transfer Company. Theodore N. Vail, Director of the American Telephone and Telegraph Company. Joseph P. Davis, Chief Engineer American Bell Telephone Company. William R. Driver, Treasurer American Bell Telephone Company. William H. Baker, Vice-president and General Manager of the Postal Telegraph and Cable Company. Gen. E. P. Meany, Assistant General Manager of the American Telegraph and Telephone Company. U. N. Bethell, First Vice-president and General Manager of the New York Telephone Company. John H. Cahill, Second Vice-president and Secretary of the New York Telephone Company. W. T. Bouchelle, Treasurer of the Empire City Subway Company. Walter Brown, Auditor of the New York Telephone Company. H. C. Vance, Engineer of the Union Subway Company. P. J. Ferrier, Superintendent of the New York Transfer Company. H. G. McCully, Superintendent of the New York and New Jersey Telephone Company. E. A. Gurnee, Cashier of the New York Telephone Company. The pall bearers were W. D. Sloan, E. A. Hussey, F. M. Tuomey J. F. Lane, William Ennis, H. M. Paddock, W. E. Huntington and P. P. Barnes.

MR. A. BALFOUR.—Mr. Alexander Balfour, a prominent business man, dropped dead in his office, in the Drexel Building, Philadelphia, on March 28. He was a director of several local banks, a director of the Keystone Telephone Company, the Union Traction, and a member of the Board of Inspectors of the Eastern Penitentiary. He was seventy years old.

PERSONAL.

JOHN H. DALE.

MR. JOHN H. DALE.—As one reads of the various legislative, financial and other efforts to check and control the trusts, and to restrict combinations of capital on general principles, it is refreshing and inspiring to note prominent examples of individual success which prove that the opportunities for energy, hard work, adherence to sound business ideas and methods are as good as ever and remain unrestricted. One of these instances is Mr. John H. Dale, President of the Dale Company, of New York., who 14 years ago, started his business in a little 10x12 shop costing the magnificent sum of $15 a month. Fourteen years seems but a comparatively short period to create and develop an enterprise now requiring the whole of the new building just occupied. Mr. Dale was almost born into the business, certainly brought up in it. He started with the old United States Illuminating Company as a boy and on his own request, after a year, was transferred to the Construction Department. There doing six years' active service, he received his first knowledge of electric light construction and engineering. Equipped with very little beyond this experience, he started a small shop of his own on Fulton St., for repairing dynamos and looking after the installation of electric lighting plants, and gradually worked into the manufacture of a few specialties in electric light fixtures. Thence he moved in 1892 to a little larger quarters on Cortlandt St., and in 1893 took a partner. After a couple of years differences of opinion resulted in serious dispute and the partner refusing to buy or sell a receivership resulted, although the concern was perfectly solvent at the time. While proceedings were still pending, Mr. Dale, nothing daunted, started a new place of his own in Centre St., and after a few weeks he managed to get back in the old premises and resume business, and though not legally obligated he gradually paid up all of the old debts. In August, 1896, the present Dale Company was organized and started business at 108 Greenwich St., out of receivership. He owned at that time less than two-fifths of the business, but under his administration and efforts the business grew and prospered and he has since acquired and paid for almost all of the capital stock. During the years 1896 and 1898 Mr. Dale traveled all over the continent of Europe, looking for means and avenues to fill the various wants of the trade, and now once a year it remains his practice to make a trip all over the United States to meet personally the customers of the company, to ascertain special wants and requirements managing to keep in touch with the industry. The business of the company is a model of system and organization. Mr. Dale consults with engineers and architects in the matter of the physical improvement of his plant and shuns no expense to have it perfect, as he believes this to be economy in the end. He has employed for years the services of the well-known expert accountant firm of W. F. Weiss, this city, which has organized his system of financial accounting and of cost accounting in manufacturing, so that the cost of production is a matter of absolute scientific analysis, far beyond the ordinary. There are none better posted than Mr. Dale on the various items of expenditure in and about his business and their relations as to cost of goods in the various stages of manufacture, selling expense, general expense and other necessary comparisons and statistics.

MR. SAMUEL INSULL, president of the Chicago Edison Company, has just returned from England where he has been spending the last three months.

JUDGE J. M. THOMAS, the "independent" telephone leader, has just returned to New York from a three months' trip around the Carribean Sea, and has resumed duties at his New York office.

THE DUKE OF MANCHESTER is a candidate for membership in the Automobile Club of America, proposed by Mr. John Jacob Astor and seconded by Mr. James Stillman.

MESSRS. DODGE & DAY, modernizing engineers, of Philadelphia, have been commissioned to report on motor equipment for the Firth-Sterling Steel Company, of Pittsburgh.

MR. HENRY C. ADAMS, JR., formerly with the Phillips Insulated Wire Company, has taken charge of the New York Sales Agency for the Clifton Mfg. Co., of Boston, Mass.

MR. J. C. BARCLAY has been appointed Assistant General Manager of the Western Union Telegraph Company. As the department of electrical engineering is subordinate to this office, its general direction will remain with Mr. Barclay.

MR. F. B. T. LEE, vice-president and general manager of John Martin Company, of San Francisco, is now in the East visiting the home offices of the various large manufacturing companies which that firm represents on the Pacific Coast.

MR. C. L. DE MURALT will return to Europe next week, ending a professional visit of several months. Mr. De Muralt so timed his return to New York to be present at the Institute meeting last Friday, at which he took part in the discussions.

MR. A. J. WURTS is to lecture before the American Philosophical Society, of Philadelphia, on April 2, on the subject of the Nernst lamp, with illustrations of the lighting. There is a report current that special reference will be made to direct current work, but this is not the case.

MR. W. E. MOORE has resigned his position as general superintendent and engineer of the Augusta Railway & Electric Co., and the Gas Light Co., of Augusta, to take effect as soon as his successor can be appointed. He is taking up similar work with the West Pennsylvania Railway & Lighting Co., of Pittsburg.

DR. WALTHER NERNST, the well-known German chemist and physicist, inventor of the Nernst lamp, etc., is due to arrive in New York City about April 3 from Europe. It is understood he will be able to participate in the proceedings of the American Electro-Chemical Society which meets here this month, as already announced.

PROF. A. G. BELL, who is on the board of the Smithsonian Institution, has volunteered to sustain part of the expense involved in bringing from Italy to Washington the remains of Mr. Smithson, the Englishman who endowed the Institution and gave it his name. It is proposed to reinter the remains in the beautiful grounds near the statue of Joseph Henry.

MR. J. P. COPLAND, a special telegraph operator, who was taking De Forest wireless telegraph material to Cape Hatteras, on a schooner, for installation there, was washed overboard in a fierce storm on Saturday last. The crew managed to save him by throwing lines to him, and then worked the schooner into safe waters. Part of the special cargo was carried away by the sea.

MR. LOUIS W. MILLER, superintendent of the Bureau of Police Telegraphs, at Rochester, N. Y., advises us that the fire alarm and police telegraph systems of the city are to be consolidated and a Bureau of Electricity created in the Department of Public Safety. This new bureau will have charge of all electrical construction and installation within the limits of the city. Mr. Miller will have the supervision of the new office.

MR. CHARLES FOSTER.—The State of North Dakota, or rather the Legislature has made an appropriation for a trolley line to be built from the Capitol building to the Northern Pacific Railway Depot in Bismarck, a distance of approximately one mile, and for a lighting plant to be installed in the Capitol building, and has engaged Mr. Charles Foster, electrical and mechanical engineer, Bismarck, N. D., to make estimates, plans, etc., for same and to superintend construction of same when built.

FATHER JOSEPH MURGAS, a Polish priest at Wilkesbarre, Pa., has devised a wireless telegraph system of his own. When asked recently how far he sent messages he replied that he frequently sent them from his home, in North Wilkesbarre, to the Polish Catholic Church in Park Avenue, two miles away. He said he was handicapped in his experiments by lack of funds and proper equipment, and also by the absence of a competant assistant. The most interesting and businesslike part of Father Murgas' experimental station is in his garden, about one hundred feet from his residence. Here a pole fifty feet high is erected for sending wireless messages to the surrounding country.

MR. GEORGE WHITE, who has surrendered the chairmanship of the London United Tramway Company to Mr. Yerkes, has had a career as striking as that of any American millionaire, according to *The London Chronicle*. A Bristol boy, one of a large family, he received a board school education. His first situation was as bookboy in the library of the Bristol Law Society at a weekly wage of five shillings. A solicitor frequenting the library took a fancy to the lad and gave him a berth in his office as runner of errands and copyist of letters. Smartness and ability raised White to a responsible clerkship. His employers were solicitors to the Bristol Tramway Company, and, anxious to retain the position, they put forward their clerk for the vacant secretaryship, and secured his appointment as their nominee. This was Mr. White's opportunity. One of the first to see the superiority of electric traction, he organized in Bristol, in 1895, the first electric tramway under the modern conditions of the Board of Trade. Four years ago, having risen to the chairmanship of the company, he electrified and extended the whole tramway system of Bristol. He has given London its finest electric tramway service, and done the same for other towns, as chairman of the Imperial Tramways Company. The ex-library boy is now a millionaire, though there is nothing in his quiet life at Bristol to disclose the fact.

EDUCATIONAL.

THE WORCESTER POLYTECHNIC ALUMNI ASSOCIATION OF NEW YORK held a well-attended and enthusiastic meeting at the Hotel Albert on Tuesday evening, March 17. The association includes seventy-five graduates of the Institute, the majority of whom hold prominent positions in various engineering and manufacturing concerns in this city. The next meeting will be held at the same hotel on April 28th and all Worcester "grads" in the vicinity are cordially invited to be present.

UNIVERSITY OF MICHIGAN.—An electrical test of the Detroit, Ypsilanti, Ann Arbor, and Jackson electric railway was recently made by some of the students in the engineering department of the University of Michigan. The test was continued over a period of about twenty-one hours, starting at four o'clock one morning and continuing until one o'clock the next morning. Readings were taken every thirty seconds during that time. The test included the central plant at Ypsilanti, and the sub-stations along the road. A test was also made of the mechanical efficiency of the boilers and engines in the central plant.

UNION COLLEGE, N. Y.—The electrical engineering course at Union College, Schenectady, N. Y., has been re-organized under the immediate direction and supervision of Prof. Charles P. Steinmetz, chief electrical expert engineer of the General Electric Company. The conditions for an electrical engineering school are unusually favorable, due to the old and well-established reputation of the College in engineering education, and the proximity and friendly disposition of the General Electric Company, whose works the student is afforded chances to see and familiarize himself with apparatus and receive information. The complete course will be published shortly in the University catalogue. It may be sufficient here to say that it will give a thorough grounding in the fundamental principles and their application to all branches of electrical engineering, such as will enable the graduate rapidly to acquire the practical experience necessary. A post-graduate course in electrical engineering has been established, which will give advanced instructions, comprising many subjects, which, while of fundamental importance in the modern development of electrical engineering, are not generally taught.

Trade Notes.

THE JOHN F. KELLY ENGINEERING COMPANY has secured offices at 149 Broadway for its engineering and contracting business.

CHANGE OF ADDRESS.—The Edison Manufacturing Company has moved its Chicago office from 144 Wabash Ave. to 304 Wabash Ave.

ASSETS OF THE COLUMBIA TELEPHONE COMPANY.—According to a newspaper report, the Williams-Abbott Electric Company, of Cleveland, Ohio, has purchased the assets of the insolvent Columbia Telephone Company, of Ottawa, Ohio.

CROSS OIL FILTERS.—The Cross oil filter, manufactured by the Burt Mfg. Co., Akron, Ohio, will be used at the World's Fair, St. Louis, in the present power plant. This make of filter was also used by the Omaha, Charleston, Paris and Buffalo exhibitions.

MAN'S PLACE.—The remarkable article by Alfred R. Wallace on "Man's Place in the Universe," which has attracted so much attention both in England and this country since its appearance in the March *Fortnightly* is reprinted entire in *The Living Age* for April 4.

THE WARD LEONARD ELEC. CO., of Bronxville, N. Y., in a new bulletin illustrates its latest types of machine and fan speed controllers. The demand for a controller of these types has increased so rapidly that new price lists have been quoted which will be of great interest to the trade.

CATALOGUES WANTED.—The Hendrie & Bolthoff Mfg. & Supply Co., of Denver, Colo., is adding an electrical supply department to its line of mining machinery and supplies. It proposes to carry a large stock of such material, and wishes to receive catalogues, prices, and price lists in the various lines.

THE BROWNING MANUFACTURING COMPANY, of Milwaukee, Wis., has just opened a Chicago office at 1600 Tribune Building, which will be in charge of R. L. Thayer, an electrical engineer who is well known in Chicago. This is another one of the many indications that this company is reaching out in a progressive manner for small motor business.

PEERLESS FANS.—Bulletins A, B, and C, recently issued by the Peerless Electric Company, Warren, Ohio, are devoted to direct current desk fans, direct current ceiling fans and alternating desk fans, respectively. These various types of machines are illustrated and described in the usual manner, all necessary trade information being given in each case.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Western agent for Gutmann wattmeters and Adams-Bagnall arc lamps, writes that its sales on lamps and meters for the past three months have surpassed those of any similar period in or out of season. Both of these factories have enlarged their facilities so that the increased business is promptly taken care of.

CUTLER-HAMMER BULLETINS.—The Cutler-Hammer Mfg. Company, Milwaukee, Wis., has just issued a set of new bulletins illustrating and giving the principal points of its motor starters, controllers, resistance, solenoid-controlled switchboards, etc., etc. These bulletins are intended to be inserted in their proper places in the "perpetual catalogue" issued by the company.

ELBLIGHT.—The Elblight Company of America has received the unanimous approval of the Electrical Committee of the National Board of Fire Underwriters. The rules governing the use of the material will shortly appear. The Elblight system has recently undergone successfully the trial of lighting one of the tunnels of the Pennsylvania Railroad, where it has been on test since August last.

INSURANCE AND ELBLIGHT.—Mr. Russell Spaulding, president of the Elblight Company of America, informs us that he has been advised by Mr. C. M. Goddard, secretary, that the Elblight system has received the unanimous approval of the Electrical Committee of the National Board of Fire Under-

writers, and that rules to gover nits use will now form part of the National Code. This action should act very beneficially in extending the popularity and use of the system in question.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., has issued a unique booklet telling all about its facilities for the production of its incandescent lamps, and calling attention to the principal points of its products. In it attention is directed to the fact that the Columbia type of lamp gives more light in the useful direction than the oval type, but does not consume any more current.

DIAMOND SPECIAL COMMUTATOR COMPOUND is not a grease but a combination of chemicals that act as a lubricant which stops sparking, puts a hard glossy finish on the commutator, prevents excessive wear of both commutator and brushes, and increases the conductivity of brushes by removing dirt and keeping a clean contact. The Central Electric Company, of Chicago, carries a large stock of this compound.

WESTINGHOUSE FAN MOTORS.—Alternating and direct current fan motors of the swivel and trunnion type form the subject of an artistic pamphlet just issued by the Westinghouse Electric & Mfg Co. The fan is well illustrated, complete and in detail, and well executed half tone views show the fan in operation in the dining-room of a large hotel and in a buffet, smoking and library car, etc. Tables give the size and prices and other facts about the two types of motors.

AUTOMATIC TELEPHONE SWITCHBOARDS.—The Clark Automatic Telephone Switchboard Company, Providence, R. I., has issued a pamphlet illustrating and describing its telephone apparatus. One of the many interesting illustrations shows a view of an automatic switchboard with a capacity for 72 subscribers. The pamphlet contains copies of various letters from individuals and concerns using the system, and these show that the apparatus is giving great satisfaction in practical operation.

FUEL OIL ENGINES.—A late design of a fuel oil engine is the Ostergren internal combustion engine manufactured by the Fuel Oil Company, 60 Wall Street, New York. This engine is designed for street cars, railway trains, yachts, stationary machinery, etc., and is built in sizes from 1 to 1,000 horse-power and upward. The chief advantages claimed for the engine are lightness and compactness and economy in the use of fuel oil, the cost for operation, it is stated, being two cents or less per horse-power per day.

TUERK ELECTRIC FANS.—The Hunter Fan & Motor Company, Fulton, N. Y., has just issued a neatly gotten-up pamphlet on its ceiling fans for alternating current. The various styles of these fans are illustrated in tinted views, and on one page is an illustration showing the various parts of the fan, numbered to facilitate ordering by mail or telegraph. A price list and a code forms part of the contents. The Eastern agents for this firm are E. B. Latham & Co., 39 Vesey Street, New York.

INTERIOR CONDUIT.—The Sprague Electric Company has just issued a new catalogue of interior conduit—iron armored, brass armored, unarmored and flexible metallic; armored cables; conduit fittings; boxes; elbows; couplings; special tools, etc. The catalogue contains 124 pages and illustrates the different styles of conduit and accessories, for the development of which this company has made an enviable reputation. A comprehensive telegraph code is provided and the entire subject is thoroughly indexed.

THE CHICAGO FUSE WIRE & MFG. CO. makes a specialty of fuse wire and strip for telephone fuses, instrument fuses, and in fact anything requiring a very low fusing point. These fine wires are made with the same degree of accuracy which has always been maintained for all this company's product, and they have sufficient tensile strength to be handled without difficulty. The company says it is in a position to take care of orders whether regular or special, and in large or small amounts, and makes shipment promptly either from its Chicago, New York or Buffalo houses.

MACHINE SHOP OUTFIT.—In a 56-page pamphlet just issued by the Garvin Machine Company, Spring & Varick Sts., New York, a very complete line of illustrations is shown of machines for a modern machine shop outfit. It comprises milling machines, lathes, cutters, tool grinders, drill presses, shapers, etc., etc. Each illustration, of which there are many, is accompanied by a brief description of the machine so represented. The Garvin Company has also issued three separate catalogues on the subjects of universal milling machines, plain milling machines and universal screw machines.

DE LAVAL STEAM TURBINES.—The De Laval Steam Turbine Company of New York, has issued a handsome pamphlet describing and illustrating its steam turbines and turbine machinery. The steam turbine is briefly discussed from the technical standpoint, this being followed by a brief history of its development. Various curves are given showing the performance of the turbines. A section devoted to a description of the construction of the turbine machinery is very complete and artistically illustrated. The pamphlet is a very complete exposition of the whole subject, and will be very valuable for reference.

TOLOR CONDUIT BOXES.—The three principal features of the Tolor system of conduit boxes are as follows: 1st. The "knockout" feature which is primarily the foundation for a perfect system of conduit boxes. 2nd. Any combination of outlets for ½ and ¾ inch pipe is possible. Cast receptacle boxes are universal and all different style covers fit all style bases. 3rd. The absolute completeness of the Tolor system, in that no condition exists in which this system of boxes cannot be applied. The Electric Appliance Company, Chicago, has just issued a most complete catalogue of conduit and conduit fittings. A copy of this catalogue will be mailed upon application.

MACHINE AND FAN SPEED CONTROLLERS.—A bulletin has been issued by the Ward-Leonard Elec. Co., of Bronxville, N. Y., covering its latest types of machine and fan speed controllers. It is stated that a special feature of these controllers is that after starting the motor, the speed can be increased or decreased with one hand. The old trouble of having to hold down the armature of the no-voltage release device with one hand, while cutting in resistance with the other hand, has been done away with. This feature, together with the independent overload circuit breaker device shown in the cuts in this bulletin, makes these controllers absolutely fool-proof.

DEERE & COMPANY, of Moline, Ill., have, at the end of a seven months' trial of the lamp of the Nernst Lamp Co., of Pittsburg, displaced their arc and incandescent lights, as rapidly as is consistent with shop practice. The large machine shop of this company, completed last July, is lighted by multiple glower Nernst lamps, giving greater satisfaction than the former system of local unit lighting. It is the intention to light the entire establishment with Nernst lamps. Another Deere interest, the Velie Carriage Company, of Moline, Ill., was led by observing the above trial to install in its plant a complete Nernst system, using a hundred lamps of the three and six-glower types.

DUNCAN INTEGRATING WATT-METER.—This instrument, which is manufactured by the Duncan Electric Mfg. Co., Lafayette, Ind., is designed for direct current lighting and power service, and embodies many of the most modern ideas peculiar to its type. It is designed to meet every requirement of those whose duty it is in the central station to test, install and inspect meters, so that their work may be facilitated, and assist in keeping the operating expense of the meter department at a minimum. In a bulletin recently issued by the company, the line of electricity meters manufactured by the company is comprehensively described and the various types and styles of instruments clearly illustrated.

TRANSFORMERS.—Bulletins Nos. 9114 and 9115 of the General Electric Company have for subjects: "Some Facts Regarding Type H Transformers" and "Transformer Economy," respectively. Considerable space is devoted to the discussion of various points in the design and construction of transformers from the central station standpoint, and particular attention is called to the improvements in the operating efficiencies of Type H transformers that have been made within the last three years. The heating guarantee on this type low-frequency transformers remains as formerly—not exceeding 45° C. rise at the end of an eight-hour run at full load—which is well within the limits recommended by the American Institute of Electrical Engineers. This temperature, moreover, is measured by increase of resistance method.

THE GORDON BATTERY.—The Gordon cell has now been on the market for several years and has established a high reputation for efficiency and general reliability. The Gordon Battery Company, New York, has just issued a very neat booklet on the subject of its cells, which will be found very useful to all interested in this method of generating electric current. To meet the requirements of the present day, a battery must needs be almost universal in its application, and it is claimed that the Gordon cell fulfills all of the requirements for closed circuit work, while it is equally efficient for open circuits. It has low internal resistance, high electromotive force and long life, and is, besides, clean and little affected by temperature changes. The pamphlet gives some information regarding primary batteries in general, and contains illustrations and prices of the various sizes and types of the Gordon cell, besides the line of Gordon supplies. The company will be glad to send a copy of this pamphlet to any one interested.

MARCONI SYSTEM IN NEW YORK CITY.—It is stated that arrangements have been made by the International Mercantile Marine Company for an installation of the Marconi system at a station on the American Line pier, North River, at the foot of Fulton Street, to enable communicaion with ships compelled by fog to lie at anchor off Sandy Hook and in the lower bay. Sometimes ships are held this way for hours and days, and during such periods are practically isolated. The station on the American Line pier will be complete in every detail. On top of the dock shed will be erected a pole 120 feet high. The sending and receiving apparatus will be located at the end of the pier. Besides allowing captains of incoming steamers to report from the lower bay, the station will permit the giving of instructions to outgoing vessels at the same point. The use of the new station will not be restricted to vessels of the International Mercantile Marine Company, but will be available to all steamers equipped with the Marconi system apparatus.

DICKEY-SUTTON CARBON CO.—This concern, which is incorporated under the laws of Ohio, has an admirable new plant on the line of the Hocking Valley Railroad Company in the suburbs of Lancaster, Ohio. The company has begun business with the production of arc lighting carbons, but is also taking up the manufacture of carbons for electrolytic work, battery work, etc., as well as brushes for dynamos and motors. It will also give attention to carbon specialties for which there is a growing demand. Not alone is the plant equipped with all the latest appliances, inventions and improvements that relate to the carbon art, but it has the advantage of excellent raw material and also has the benefit of natural gas for its ovens. The equipment was installed under the direction of Mr. Edmund Dickey, well known as a master and expert in the field. He is also general manager and vice-president. The other officers are Mr. H. M. Sutton, president; Mr. U. S. Colby, secretary; Mr. S. S. Wilson, assistant secretary; Mr. R. R. Dickey, superintendent.

THE WILLYOUNG & GIBSON COMPANY, which we referred to in one of our recent issues as having been incorporated for the purpose of taking over the instrument business of Elmer G. Willyoung, has just completed its removal to new quarters in the Steeple Building, No. 40 West 13th Street, New York City. The ground floor of this building has been rented by the company for a term of years, and has been very handsomely and completely fitted up as a high-class instrument shop. A considerable amount of new machinery has been installed, including precision lathes, automatic screw machines, milling machines, etc., and every facility has been secured for the doing of the high-class work for which Mr. Willyoung has always been known. The test room particularly has been very carefully looked after and is a separate department which has been very carefully fitted up with the necessary standards and calibrating apparatus; this part of the work is in charge of Mr. W. M. Comstock, for some years past a member of the teaching faculty at Columbia University. Altogether about 6,000 square feet of space is occupied, and with the increased facilities the company expects to expand its already considerable business. Besides its line of routine apparatus, special attention will be devoted to new problems of measurement and their solution for inventors and scientists. A thoroughly competent designing staff is placed at the disposal of those wanting such facilities. The company invites visitors and correspondence at the new address.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 24, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,103. TELEPHONIC APPARATUS; C. G. Burke, Brooklyn, N. Y. App. filed February 3, 1903. (See page 562.)

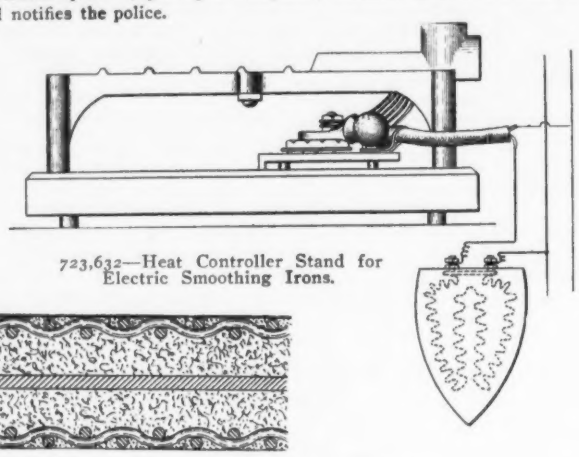
723,253. TELEGRAPH KEY; W. E. Duncan, Macon, Ga. App. filed Nov. 11, 1902. The key lever is of spring metal in one piece with the base.

723,259. ELECTRIC SIGNALING DEVICE; W. Fraser, New London, Conn. App. filed Aug. 12, 1902. A therapeutic device.

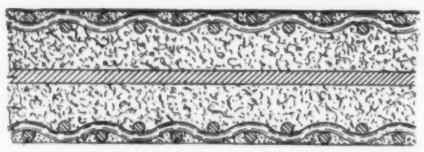
723,261. AUTOMATIC RELEASE DEVICE FOR RHEOSTATS AND HEATERS; C. E. Freeman, Chicago, Ill. App. filed Dec. 12, 1901. The movable core of a magnet is a pin which enters a notch in the lever of the rheostat to normally hold it in place.

723,309. TELEPHONE ATTACHMENT; J. P. Riedinger, Oberlin, Ohio. App. filed September 13, 1902. (See page 562.)

723,320. ELECTRIC BURGLAR ALARM; S. Schwarzschild, Rochester, N. Y. App. filed Sept. 3, 1901. The burglar alarm traverses a subscriber's telephone circuit and operates the annunciator at central office as if it were a call. Central operator, getting no response, surmises that it is a burglar alarm and notifies the police.



723,632—Heat Controller Stand for Electric Smoothing Irons.



723,326—Armored Element for Electric Batteries.

723,321. ELECTRIC DISPLAY SIGN; F. M. Sheridan and E. Behrendt, New York, N. Y. App. filed May 6, 1902. A perforated contact plate is adapted to be fitted over pins forming the terminals of the sign lamps, the perforations on the plate being arranged in the form of a letter.

723,326. ARMORED ELEMENT FOR ELECTRIC BATTERIES; E. A. Sperry, Cleveland, Ohio. App. filed May 25, 1901. A stiff fabric is incorporated with the active material near the surface to form a retaining envelope or armor.

723,327. STORAGE BATTERY; E. A. Sperry, Cleveland, Ohio. App. filed Aug. 12, 1901. A composition consisting of finely divided metallic lead moistened with a mixture of a neutral liquid and ammonium hydroxid.

723,328. STORAGE BATTERY; E. A. Sperry, Cleveland, Ohio. App. filed Aug. 12, 1901. A composition consisting of active material, ammonium sulphate and a catalytic agent.

723,360. TROLLEY REVERSER; F. H. Burnham, Essex, Mass. App. filed March 10, 1902. A retrieving device to prevent the trolley from rising when it leaves the wire.

723,362. PROCESS OF CONCENTRATING ORES; H. F. Campbell, Melrose, Mass. App. filed Aug. 16, 1902. The ores are heated to render certain portions paramagnetic and are then passed through a magnetic field of a strength inversely proportional to the degree of exposure to heat.

723,363. PROCESS OF CONCENTRATING ORE; H. F. Campbell, Melrose, Mass. App. filed Feb. 18, 1903. A modification of the preceding process.

723,369. APPARATUS FOR MEASURING ELECTRICAL RESISTANCES; R. W. Conant, Cambridge, Mass. App. filed Sept. 29, 1902. A testing set especially designed to measure the resistance of rail joints.

723,385. TROLLEY WHEEL; N. T. Hazen, Newburyport, Mass. App. filed Feb. 5, 1902. Details of a device for preventing the trolley from leaving the wire.

723,398. ART OF OPERATING ELECTROLYTIC CELLS; E. A. Le Sueur. Sault Ste Marie, Canada. App. filed April 24, 1901. (See page 562.)

723,441. MEANS FOR OPERATING THE POINTS OF OVERHEAD WIRES ON ELECTRIC RAILWAYS; H. Collins and C. W. Collins, Manchester, Eng. App. filed June 9, 1902. A switch in the overhead trolley wire can be moved by the motorman through mechanical devices extending from the track to the overhead structure.

723,449. ELECTRODE FOR STORAGE BATTERIES; T. A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902. Active material is deposited in a pocket in the plate which pocket has concaved surfaces.

723,450. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed November 28, 1902. (See Current News and Notes.)

723,451. STORAGE BATTERY; J. B. Entz, Philadelphia, Pa. App. filed Aug. 28, 1900. The end plates have an integral hook, the bill of which presses against the outer wall of the cell to hold the plate in position.

723,471. HOLDER FOR TELEPHONE-RECEIVERS; S. Konigstein, San Francisco, Cal. App. filed December 19, 1901. (See page 562.)

723,478. BURGLAR ALARM; G. W. Mills, Elizabeth, N. J. App. filed April 15, 1902. A small casing containing a battery and an electric bell is placed behind the door; the opening of the door moves a push button on the casing and sets the bell in operation.

723,510. EDISON SCREW SWITCH HOLDER FOR INCANDESCENT LAMPS; O. Zielinski, Berlin, Germany. App. filed May 17, 1902. Details.

723,592. ELECTRIC RAILWAY; H. Edwards, Boston, Mass. App. filed June 16, 1902. Switching apparatus for a sectional rail system.

723,607. SECTIONAL ELECTRICAL SWITCHBOARD; T. W. Jardine, Englewood, N. J. App. filed Aug. 8, 1902. The switchboard is built up of sections, each of which carry in a fuse and switch corresponding to branch circuits. Any number of sections may be placed together and interconnected.

723,631. METHOD OF HEATING MATERIAL; E. G. Acheson, Stamford Township, Can. App. filed September 26, 1902. (See page 562.)

723,632. HEAT CONTROLLER STAND FOR ELECTRIC SMOOTHING IRONS; J. I. Ayer, Malden, Mass. App. filed Jan. 9, 1902. The resistance ordinarily thrown into circuit to replace the iron when the latter is out of use, is applied to the stand which is thereby heated and the heat utilized to keep the idle iron at high temperature.

723,633. HEAT CONTROLLER STAND FOR ELECTRIC SMOOTHING IRONS; J. I. Ayer, Malden, Mass. App. filed Jan. 6, 1902. A modification of the preceding patent.

723,634. ELECTRIC SOLDERING IRON STAND; J. I. Ayer, Cambridgeport, Mass. App. filed Nov. 13, 1902. A further modification involving control of the circuits by the weight of the tool on the stand.

723,635. ADJUSTABLE SUPPORT FOR TELEPHONE-RECEIVERS; F. J. Becker, Hamilton, Ohio. App. filed August 8, 1901. (See page 562.)

723,643. ELECTRIC FURNACE; C. S. Bradley, New York, N. Y. App. filed June 19, 1900. (See page 562.)

723,646. TROLLEY; H. H. Bryant, Allegheny, and J. B. McGaw, Pittsburg, Pa. App. filed Nov. 26, 1902. Details

723,690. SWITCH FOR ELECTRIC RAILWAYS; G. W. Linder, Baltimore, Md. App. filed Oct. 18, 1902. Details of a trolley wire switch.

723,717. ELECTRIC CONDUCTOR; J. D. Nicholson, Pittsburg, Pa. App. filed August 17, 1900. (See Current News and Notes.)

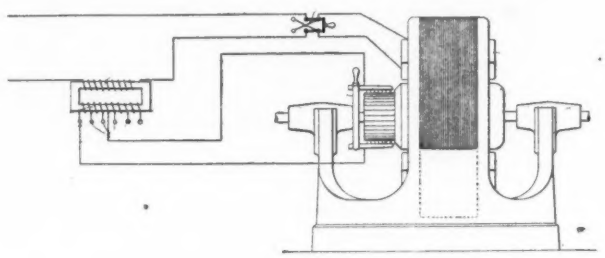
723,727. CAR OR VEHICLE PROPULSION; P. Pfeil, Chicago, Ill. App. filed Oct. 14, 1902. An arrangement for utilizing the momentum of a car when running down hill or coming to a stop to store current for lighting purposes.

723,732. ELECTRIC SWITCH; C. W. Rogers, Newmarket, N. H. App. filed Jan. 15, 1902. A cross bar having a contact at each end is forced downward to close the circuit by means of a centrally located rotating cam.

723,742. TELEPHONE-RECEIVER SUPPORT; D. W. Shiek, Chicago, Ill. App. filed October 21, 1901. (See page 562.)

723,766. ELECTRIC HEADLIGHT LAMP; H. P. Wellman, Ashland, Ky. App. filed June 4, 1902. The magnet coil, arc inclosure, clutch, etc., are compactly arranged and capable of being easily removed from the lamp casing.

723,786. ALTERNATING CURRENT MOTOR; A. W. Schramm, Philadelphia, Pa. App. filed July 26, 1902. The field coils are in series with the primary winding of a transformer and the supply circuit, the secondary winding of



723,786—Alternating Current Motor.

the transformer is in a closed circuit with the armature and a reversing switch is arranged to change the connections of the secondary winding.

723,788. RESISTANCE BOX; S. S. Wales, Munhall, Pa. App. filed Nov. 29, 1902. Details of a structure wherin a series of separate grids are assembled into panels.

723,791. CONNECTOR FOR ACCUMULATOR PLATES; G. A. Washburn, Cleveland, O. App. filed July 28, 1902. The connectors are cross pieces having openings to receive the lugs of the plates and adapted to rest upon the upper edges of the cells.

723,797. ELECTRIC THERMAL THERAPEUTIC BLANKET; W. W. Williams, Springfield, Ohio. App. filed Nov. 3, 1902. A switch is adapted to cut in different portions of the heating resistance which extends throughout the structure of the blanket thereby making it possible to heat particular portions of the body desired.